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HOW TO DETERMINE TRAINING DEVICE REQUIREMENTS AND CHARACTERISTICS: A HANDBOOK FOR TRAINING DEVELOPERS

ARI FIELD UNIT AT FORT BENNING, GEORGIA

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This handbook was prepared for use by U.S. Army training developers and others accountable for determining requirements for and characteristics of training devices to support hardware fielding. It contains a description of a methodology for performing the front-end analysis needed to determine what tasks have to be trained (training requirements); the need for a training device(s) as a medium for developing required task skills (training device requirements); and the characteristics that the device should possess in order to promote effective learning (training device characteristics). The handbook supplements

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and extends the contents of ISD Pamphlet 350-30 in that it: (1) further details the process for developing task descriptions and acquiring other job information needed to assess the demands imposed on the operator by the equipment, operational environment, other crew members and interactive systems; (2) provides additional criteria and rating scales for use in the task analysis process; (3) allows for specific identification of requirements for training equipment (actual or device) as opposed to the ISD process which leads to the identification and selection of generic training media alternatives; and (4) leads to the identification of specific characteristics of devices needed to provide the essential skills training.

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HOW TO DETERMINE TRAINING DEVICE REQUIREMENTS AND CHARACTERISTICS: A HANDBOOK FOR TRAINING DEVELOPERS.

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FOREWORD

This handbook was prepared by Dunlap and Associates, Inc. for the U. S. Army Research Institute Fort Benning Field Unit under Contract DAHC 19-78-C-0016. It is directed toward the audience of U. S. Army training developers and describes the development and application of task analysis to determine tasks to be trained, training device requirements and training device characteristics.

The methodology described herein was applied to the Infantry and Cavalry Fighting Vehicles (IFV/CFV), two versions of the same vehicle being developed by the Project Manager, Fighting Vehicle Systems. One objective of this development program was to define and develop the family of training devices required to train both infantry and armor personnel manning similar positions in their respective vehicles. The techniques described in this handbook were developed to allow this definition and subsequent development.

ARI research in training systems development is conducted as an inhouse effort augmented by contracts such as this one. This project was conducted as part of Army Project 2Q263743A773, FY 78 and 79 Work Programs; and Project 2Q263743A794, FY80 Work Program. It was directly responsive to the needs of TRADOC Systems Manager, Fighting Vehicle Systems; US Army Infantry School; US Army Training Support Center, Devices and Systems Training Directorate; and Project Manager, Training Devices.

JOSEPH ZEIDNER
Technical Director

HOW TO DETERMINE TRAINING DEVICE REQUIREMENTS AND CHARACTERISTICS:
A HANDBOOK FOR TRAINING DEVELOPERS

BRIEF

Requirement:

Training developers have lacked the analysis tools necessary to adequately define the requirements for training devices. The needs are to better identify which tasks require a training device or equipment as a training medium and to define the necessary device characteristics.

Procedure:

The state of the art in "front end analysis" methods and procedures was evaluated. The approach used in the Instructional Systems Development (ISD) model was adopted and extended to allow better definition of training device requirements in terms of tasks specification and to also allow the identification of necessary training device characteristics. The viability of the developed methods and the utility of the resulting products were evaluated through application to the Infantry Fighting Vehicle/Cavalry Fighting Vehicle (IFV/CFV) systems. The methods were then translated into this handbook for use by the training developer.

Findings:

(1) The developed methods and procedures were applied successfully to the IFV/CFV systems within the training developer's working environment using available resources.

(2) Products resulting from application of the methods provide detailed, essential, requirements for training equipment. These products provide the support and information needed to back up training device requirements documents (TDRs). They also provide the foundation needed to develop better procurement specifications and, subsequently, to perform better cost and training effectiveness analyses and tests.

(3) This handbook provides guidance to the effect that, to the extent task descriptions have already been developed and are available, the training developer should make use of these descriptions. Based, however, on experience with the IFV/CFV program and other programs, the training developer would be well advised to expect that, although some task descriptions may already have been developed, considerable additional effort may be required. Available IFV/CFV task description data were both incomplete and insufficiently detailed, and considerable task description effort was required.

Utilization of Findings:

The details of "what to do" and "how to do it" to determine the requirements for and necessary characteristics of training devices are contained in this handbook. The handbook is intended for use by TRADOC (U.S. Army Training and Doctrine Command) school personnel, training developers in the other military branches, and contractors who must address the question of whether or not training equipment is necessary and should be developed. TRADOC is considering circulation of this handbook as a pamphlet or circular so as to better institutionalize it's usage.

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1.0 INTRODUCTION

1.1 Purpose

This handbook has been prepared for use by U.S. Army training developers and others accountable for determining requirements for and characteristics of training devices needed to support the fielding of hardware. It contains an approach of how to perform the front-end analysis needed to determine: 1) what has to be trained; 2) the need for a training device(s) as a medium for developing required skills; and, 3) the characteristics that the device(s) should possess in order to promote effective learning. Application of the methodology described herein will enable the training developer to define and support his requirements such that training device requirements documents can be prepared to initiate the device development program.

1.2 Relationship to Instructional Systems Development

Instructional Systems Development (ISD) is a systems approach to training that had its beginnings in systems and jobs analysis. The primary goal of the ISD process is to produce performance-oriented training so that the learning experience leaves trainees with observable and measurable skills that can be applied to their jobs. The data base for ISD is an objective and comprehensive description of all individual and interactive (crew) tasks that are performed by a job incumbent(s) in an operational or working environment. Although the ISD process has been described and modeled in different ways, the core of the process consists of analyzing tasks to determine what should be trained; how training should be structured and presented; and, what and how to measure trainee progress and the success of the training program.

This handbook supplements and extends the contents of the ISD pamphlets (TRADOC Pam 350-30) in that it: (1) further details the process for developing task descriptions and acquiring other job information needed to assess the demands imposed on the operator by the equipment, operational environment, other crew members and interactive systems; (2) provides additional criteria (task characteristics) and scales for use in the task analysis process; (3) allows for specific identification of requirements for training equipment (actual or a device) as opposed to the ISD process which leads to the identification and selection of generic training media alternatives; and (4) leads to the identification of the specific equipment characteristics needed to provide the essential skills training. To the extent work on developing the training system for the equipment is in process or has been done previously (e.g., on already fielded equipment) then some portions of the process described herein may have been completed. The training developer must assess the current state of development of the system for which training is being developed and utilize any completed and related work performed by the schools or the materiel developer to support the process for determining training device requirements and characteristics.

1.3 Limitation

The procedures in this handbook will identify those tasks which could benefit from the use of equipment in training. The procedures cannot completely determine whether a training device (as opposed to actual equipment) is needed for training. This question is partially addressed in step 9.4, where a variety of conditions affecting the ability to perform some operational tasks in the training situation are considered (e.g, costs and difficulty of simulating live multiple target engagements). Such conditions may direct that training of such tasks can most eonomically be done with a training device or simulator. The question of whether the training device specified by the developing agency or an "actual equipment trainer" will be most cost and training effective must be resolved early in device development. this must be accomplished by a cost and training effectiveness analysis (CTEA). The handbook products - specification of tasks requiring training equipment support and of essential device characteristics - will be necessary inputs to the conduct of the CTEAs.

1.4 Approach

The approach consists of two phases, task description and task analysis. Each phase consists of several steps. The phases and steps are outlined in a block diagram in Figure 1. The overall approach is summarized below.

Training programs are developed for new emerging systems, existing systems or modifications to existing systems. Regardless of the state of system development, the training developer must first identify and describe those tasks that have been allocated to humans to be performed in the operational environment. This is the initial and perhaps most crucial step in the task analysis process as these data are the basis for developing a valid and effective training program. It is imperative to develop a data base that provides sfficient information about the individual job being analyzed as well as data on "when," "where" and "how" that individal job (operator position) interacts with other jobs in the system or between other systems. To accomplish this end, task descriptions are first developed and validated for the operation of the system in the conduct of one or more missions (Figure 1, Blocks 1.0 - 4.0). Following the validation of task descriptions the individual and interactive tasks are organized by operator position for task analyses (Block 5.0). Block 5 would be bypassed if the system is manned by only one operator, acting independently of other personnel.

The collection of training data (Block 6.0) is a continuing process that can commence concurrently and as a parallel effort with any of the preceding steps or events in the methodology. These data will later impact the determination of training device characteristics (Block 10.0).

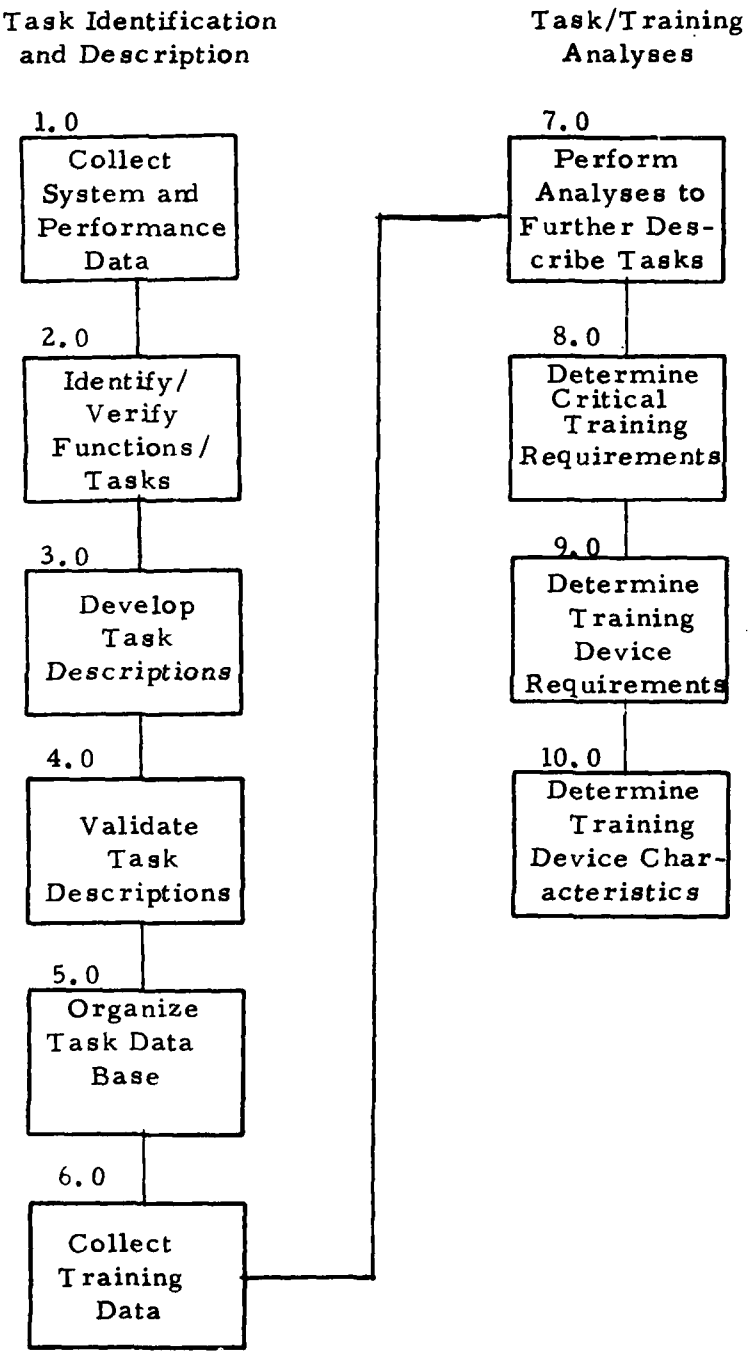


Figure 1. Steps in the Methodology for Analyzing Tasks to Determine Training Device Requirements and Characteristics.

Having established comprehensive and valid task descriptions, the next step is to prepare for and conduct analyses to further describe tasks (Block 7.0). Activities in this step include the selection of evaluation criteria and rating scales, the development of data collection forms, the selection of subject matter experts (SMEs) to act as respondents to the data collection forms and the conduct of group interviews. It is important that this step be well planned and executed because subsequent analyses are only as good as the data that go into them.

The ultimate objective of the methodology is to identify training device requirements and characteristics. The first step in analysis to meet this objective is to determine which of the system operator tasks will require training (Block 8.0) and the criticality of this need. This step requires evaluating each task against several criteria. The several criteria (and resulting values) are then combined into a Training Requirements Priority Index (TRPI). This index allows the training developer to order the tasks with respect to training criticality and to eliminate low priority tasks from further consideration.

The next step is to identify which of the tasks selected for training require a training device (Block 9.0). To support this decision, tasks selected for training are analyzed against criteria which, when considered collectively, identify requirements for a training device. These criteria include: 1) a Practice Requirement Index (PRI) that is based on selected task characteristics; 2) the skills required to perform the task; 3) the job aids provided to support performance of the task; and 4) the conditions (internal and external) having a significant effect on task performance. The tasks that remain after the screening process in Block 9 constitute the training device requirements and enter Block 10.

The final step (Block 10.0) is to determine the characteristics of the training device that are necessary to promote the learning process in the final set of tasks. This step involves analyzing the remaining tasks and training planning data to determine the physical and instructional characteristics of the device. Physical characteristics relate to "what" must be simulated in the device to develop and exercise those skills that are required to perform the tasks in the real job or operational situation. Instructional characteristics are those features of the training device that enhance the acquisition of learning.

Documentation describing the training device requirements, i.e., the tasks from Block 9, and the necessary device elements and element characteristics from Block 10 constitute supporting documentation for training device requirements (TDR) statements and should be referenced or contained in the TDR. Products to be provided to the materiel developer to start the development process include the product of Block 5, the detailed task descriptions, as well as the products of Blocks 9 and 10. These products

provide information essential to the development of specifications for the desired training device.

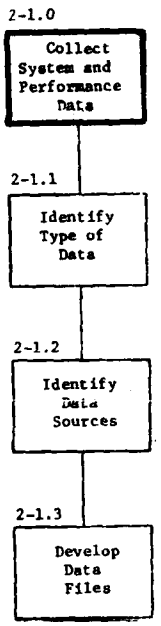
1.5 Organization of Handbook

The steps in the methodology shown in Figure 1 are divided between those that are performed to "describe" tasks and those to "analyze" tasks. Section 2.0 of the handbook defines each step and briefly describes "What to Do" in order to accomplish that step. Section 3.0 is the "How to Do" of the handbook and it describes the methods and procedures required in order to attain the objective identified in each step of the methodology. The block numbers given in Figure 1 are used to identify the steps in Sections 2 and 3. The examples provided in Section 3.0 are taken from the research performed to determine training device requirements and characteristics for the Infantry and Cavalry Fighting Vehicles (IFV/CFV).

2.0 WHAT TO DO

Overview

Most military training devices are developed to support either specific materiel systems or items of equipment, which, with their personnel component, constitute man-machine systems. These individual systems are comprised of people and equipment working together under variable conditions and environments to control, operate and maintain the system so that it can accomplish the objectives for which it was designed. The training developer, given the responsibility to identify training device requirements and characteristics, must become familiar with the system and its missions and functions in order to describe the task demands occurring in the operational or real work environment. These task descriptions are used as the data base for performing the task analyses, the results of which are combined with training planning data to support design decisions during training program development. This section contains descriptions of "What to Do" when a training developer is required to develop task descriptions, collect training data, and then analyze these descriptions and data to determine training requirements, training device requirements, and characteristics. Each major block (step) shown in Figure 1 is divided into sub-blocks (sub-steps) that identify "What to Do" to attain the objective of that major step in the methodology.



2-1.0 Collect System and Performance Data

System and performance data are generated and documented by the user command and the materiel developer during all phases of system development. Data most beneficial to the training developer are those that describe the missions and goals of the system, the functions the system will perform, the equipment and personnel provided to implement the functions, and the conditions of operation and standards of performance. The availability of these data will depend upon the stage of system development and whether it is a new or existing system. For new systems under development, modifications and changes to system functions and operator tasks will occur as a result of design reviews and test and evaluations. The training developer should remain abreast of these changes, assess the impact on the collected performance data and update or correct as required. The collection of system and performance data allows the training developer to learn the system, its objectives, and operational requirements. These data also provide inputs to the development of a data base from which decisions can be made regarding the development of an instructional system.

2-1.1 Identify Type of Data

The type of data to be collected focuses on system performance in general and human performance in particular. Data collection efforts are directed to the following subject areas:

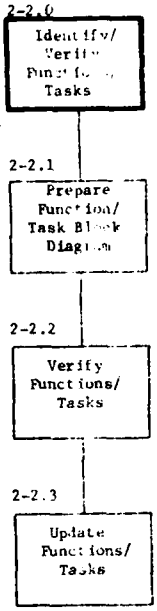
- Mission requirements
- System performance requirements
- System operational requirements
- Equipment characteristics and performance requirements
- Human performance requirements and standards
- Contingency and emergency modes of operation
- Personnel and equipment safety reqirements and operations
- Allocation of individual and interactive operator tasks.

2-1.2 Identify Data Sources

The primary sources for system and performance data are the operational commands, materiel developer, and various departments in the proponent school. Each of these sources is made up of individuals who have developed expertise in utilization and operation of the system for which training is being developed. For existing military systems, these SMEs are job incumbents, supervisors and instructors; for new systems, operators, supervisors and instructors of systems similar to the one under development and personnel in the user and materiel developer organization. These groups publish system and performance data in documents such as Materiel Needs, System Specifications, Field Manuals (FMs), Soldier Manuals (SMs), Technical Manuals (TMs), Training Circulars (TCs) and Draft Equipment Publications (DEP). During the course of system development, system descriptive data are developed as working documents for design and development that are not circulated for general use. Data such as mission scenarios and profiles, function and task analyses, and task and equipment descriptions provide valuable inputs to training program development. Also performance data can be collected during the simulation tests of partial or full equipment and of operator station mockups by engineering personnel. Observation and discussions with system designers can provide the training developer with further useful system and performance data.

2-1.3 Develop System and Performance Data Files

Regardless of whether the system is new or an existing one for which ISD materials are being developed, the training developer must become thoroughly familiar with the system and its performance requirements so that he can adequately describe it. The sources of data identified in paragraph 2-1.2 produce a myriad of system performance and training data that the training developer must assimilate, review, assess, record and retain for future use in the preparation of task descriptions and analyzing tasks. Data forms are prepared to record the relevant data abstracted from documentation, obtained through interviews with SMEs or by observation of performance during system and subsystem tests. If the system is new and under development or if it is an existing system undergoing modification, the performance and training data file must be updated periodically to reflect any changes in design or operation. This effort is continual until the system reaches "design freeze."



2-2.0 Identify/Verify Functions/Tasks

Functions are actions that a system performs in order to accomplish its objectives and goals. They are generally identified through review of documentation (obtained in Step 1) that describe the system's operational requirements and missions. Tasks are the top level descriptions of the operator actions needed to implement the system functions. Tasks are identified through detailed examination of the system design and requirements for human operation. Initially identified system functions and tasks must be verified to ensure their completeness and accuracy prior to starting the next step: Step 3, the preparation of detailed descriptions of the activities needed to accomplish the tasks.

2-2.1 Prepare a Mission-Oriented Function/Task Block Diagram

During the collection and review of system and performance data, the training developer identifies and records statements of activities or actions that are performed to exercise the system in its operational environment. These activities are stated as functions (in verb-noun phrases) and presented in the form of a mission-oriented function block diagram that shows a composite of all system functions, the relationship between the functions and their sequence of occurrence during the performance of a mission. This diagram is then used as a working document by the training developer. Its modular and symbolic format facilitates the entry of modifications or additions as more information becomes available or as system changes occur.

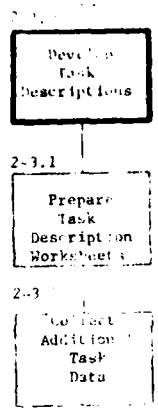
2-2.2 Verify Functions/Tasks

Verification of functions/tasks is done through SME review. SMEs must be knowledgeable and/or experienced with the system or with similar systems. SMEs must be from both the user command and the material developer when possible.

2-2.3 Update Functions/Tasks

The additions, deletions and modifications made by the SMEs reviewing the data are incorporated into the inventory to ensure a valid data base from which to proceed with the development of task descriptions.

2-3.0 Develop Task Descriptions



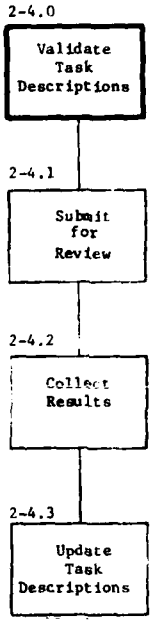
For purposes of developing ISD materials, a task can be defined as a measurable unit of work, having a distinct beginning and ending, and directed toward accomplishing a function. A task description contains statements of basic task requirements that describe, in action terms, "How" and with "What" the operator accomplishes the task. The "How" refers to the inputs, processing, actions and feedback required to accomplish the task; the "What" refers to the equipment acted upon and any other items such as job aids or test equipment that are provided to support the operator in performing his job. The description of tasks required to accomplish the system functions provides a data base for analyzing tasks to develop key elements of an instructional system, i.e., "What" to train and "How" to train.

2-3.1 Prepare Task Description Worksheets

Generally many tasks are required to accomplish a specific system function. A task description worksheet is prepared for each task that identifies the function in which the task is performed, "how" and with "what" the task steps are performed, the operator or operators allocated to perform the task and the task steps, and the operator performance standards required to accomplish the task successfully.

2-3.2 Collect Additional Task Data

The initial collection of system and performance data (Block 1.0) often does not provide sufficient information to adequately describe the tasks allocated to operators in the system. This is especially true for a new system under development. The training developer must identify his needs and contact SMEs in the user and materiel developer organizations or the proponent school to obtain the additional task information. If no data are available, the training developer must analyze each task to identify the inputs, processing, actions and feedback requirements and then identify "how" the materiel developer is planning to implement these requirements. Any noted design deficiencies should be reported to responsible individuals.



2-4.0 Validate Task Descriptions

Validation of task descriptions means determining that the data are unambiguous, accurate, complete and describe the tasks as they are performed in the operational environment.

2-4.1 Submit for Review

An expedient and efficient way of validating task descriptions is to submit them for review by SMEs in the user command and the proponent school. These SMEs should have knowledge and experience in areas related to the functions being performed by the system during a mission. This group could include SMEs in maintenance, tactics, weapons, supply, NBC, etc.

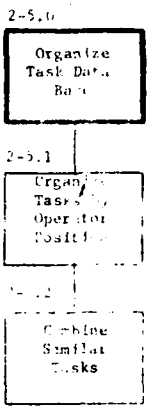
2-4.2 Collect Results

Whenever practical, the review of task descriptions by SMEs is followed up by personal interviews with them to evaluate and collect their corrections, additions and deletions. Alternative means, such as the mail, are not as expedient and the reviewers' comments are more prone to misinterpretation.

2-4.3 Update Task Descriptions

Comments received from the SMEs are evaluated and combined and the task descriptions modified accordingly. These descriptions provide the base for developing a valid and effective training program. For new systems under development, task descriptions should be continuously updated to reflect any system modifications that will impact operator tasks. This procedure should continue up to design "Freeze" for production.

2-5.0 Organize Task Data Base



Up to this point, the objective has been to develop a data base of task descriptions that is both complete and accurate. The orientation has been towards description of all tasks needed to accomplish the system's mission. Now these data need to be organized to eliminate redundancies and to establish a basis for the development of training programs and devices which will train for position assignments within the system.

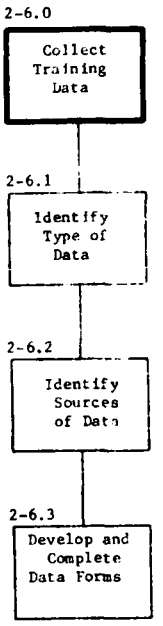
2-5.1 Organize Tasks by Operator Position

The task descriptions developed up to this point cover a system generally comprised of more than one operator working as a team to accomplish the functions and tasks required during a typical mission occurring in an operational environment. Consequently, the tasks are identified as system tasks and the activities required to accomplish the task are identified as being performed by one or more operators in the system. This approach permits the identification of all individual and interactive tasks and also provides an indication of the frequency of task performance. For purposes of subsequent analyses, the system task descriptions are now organized by individual operator position; i.e., the worksheets are now duplicated as necessary and organized so that there is a complete set of task descriptions for each position. Where tasks are performed by more than one individual in an interactive mode, it is necessary to determine which task steps are performed by which operators, to note the interactions in the task description, and to identify the other operators. The interaction information will later provide an indication of possible needs for collective or team training.

2-5.2 Combine Similar Tasks

Task descriptions based on exercising the system in a mission-oriented environment describe the tasks sequentially and in their order of occurrence during the mission. As a result, tasks may be repeated because the system must accomplish the same function at different points in time during the mission or, the same task is being performed to accomplish a different function. When organizing descriptions according to each operator position, similar tasks are combined into a single task.

2-6.0 Collect Training Data



The collection of training data parallels collection of system and performance data. These data do not impact the development of task descriptions but are used during the analysis phase to determine training device characteristics.

2-6.1 Identify Type of Data

The data to be collected focus on the proposed sites (institution, Army Training Center (ATC), unit) for training. Data collection efforts are channeled to obtain data with regard to the following:

- Proposed sites for individual and collective training
- The type of training (primary or secondary) to be provided at each site
- Expected number of trainees per class
- Instructor to trainee ratios
- Facilities available at proposed training sites
- The amount of training time proposed.

2-6.2 Identify Sources of Data

For a new system, major sources of training data will be those personnel involved in the development of the Individual and Collective Training Plan. In some cases, another important source would be contractor materials which may be obtained through the materiel developer. SMEs on similar systems (e.g., instructors from the weapons department) are also an important data source.

2-6.3 Develop and Complete Data Forms

The availability of training planning documentation is contingent upon the training developer's time of entry into the system acquisition process. Data forms for conducting structured interviews and recording should be developed and used during the initial collection of data and should be updated as additional information becomes available or modifications are made to the initial training planning information.

2-7.0 Perform Analyses to Further Describe Tasks

The organized task descriptions resulting from step 5 are now subjected to analyses on criteria which further describe the performance and training characteristics of each task. The data generated by these analyses are then used in the next steps to determine which tasks constitute critical training requirements and, of these tasks, which ones require a training device or equipment as a training medium.

2-7.1 Identify/Select Task Evaluation Criteria

The criteria selected to further describe each of the tasks must be relevant to performance in the operational system and must provide information needed to make the determinations described in the above paragraph. The following criteria will satisfy these requirements in most instances and their use, in toto, is recommended. The methods presented for steps 8, 9, and 10 will assume that these are the selected criteria:

- Criticality of task performance
- Newness of the task to the MOS to be trained (i.e., the proposed system operators)
- Difficulty of task performance in the operational environment
- Frequency of task performance under combat conditions
- Frequency of task practice necessary to maintain proficiency
- Delay tolerance of task, i.e., whether the task must be performed immediately upon receipt of information or some delay time is permissible
- Conditions, both internal and external to the system, affecting task performance
- Task performance standards

- Job aids provided on-the-job to support task performance
- Skills involved in performing the job
- Type of coordination involved in interactive or team tasks, i.e., those tasks involving two or more operators.

2-7.2 Identify Training Data

In addition to the training data requirements identified in paragraph 2-6.1, further analyses are made of the tasks to identify which site (school, ATC, unit) will provide initial (primary) training for that task and which sites will provide secondary training, i.e., transitional or reinforcement training.

2-7.3 Identify Resources

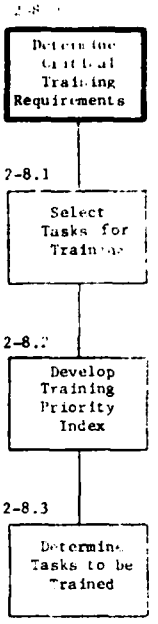
The primary resources used to evaluate the tasks against these criteria are SMEs from operational commands and proponent schools. SMEs should have knowledge and experience in the functional areas of the subject system or with other systems performing similar functions.

2-7.4 Develop Data Forms and Collect Data

Descriptions of each of the tasks with respect to the selected criteria and training questions is best accomplished through group sessions with the SMEs. The training developer must prepare the data forms, present them to the SMEs, and actively participate in the administration and control of the analytic process used by the SMEs to complete the data forms. The following materials are developed for and used in the data collection process:

- Mission-oriented task descriptions organized by operator position
- Descriptions of the criteria that are used to evaluate the tasks and definitions of rating scales and codes
- Procedural instructions
- Data recording forms

2-8.0 Determine Critical Training Requirements



This step determines which of the many system tasks actually require training to assure successful system performance. It is a two stage process: identifying tasks which need no training; and, for the others, prioritizing the degree of training requirement.

2-8.1 Select Tasks for Training

All system required tasks are screened to eliminate from further consideration those which are either non-critical to system performance, or are tasks identical to tasks already performed by entry-level system operators/ maintainers, or are extremely simple to perform and thus require no training. All such tasks are eliminated. The remaining tasks will be prioritized based on the training need.

2-8.2 Develop Training Requirement Priority Index (TRPI)

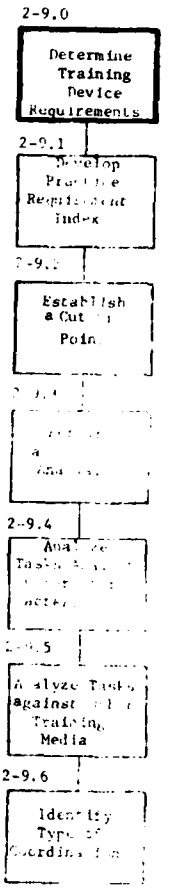
All tasks which require training must now be evaluated as to the criticality of that requirement. SME ratings for each task on the criteria of "Criticality", "Task Newness" and "Frequency of Task Performance in Combat" are multiplied together to produce a value that is termed the TRPI. This value indicates the relative importance of the task for combat and the importance of providing training on the task to the probable success of the mission. This index can be used by the training developer to structure training to emphasize more important tasks and, if training resources are restricted, to reduce or eliminate training on those tasks of lower priority.

2-8.3 Determine Those Tasks to be Trained

The TRPI generated for each task defines its relative importance for training. All tasks for which a TRPI was developed are judged to require training. But, depending on training time and cost constraints, it may not be possible to train on all these tasks in a given training program. The training developer, after considering the number of tasks requiring training and these constraints, can set a maximum number of tasks to be trained; or, conversely, a minimum level of the TRPI which will be used as a cut-off point for selecting tasks for further analysis. Remember, there is no necessity that any tasks be eliminated from further analysis at this point. Such elimination should occur only on the basis of valid constraints of time and resources for either the analysis or the training.

Tasks selected here are subjected to the next analysis, determination of training device requirements.

2-9.0 Determine Training Device Requirements



Most ISD models advocate performing a detailed media analysis for all identified training requirements. This step in this model focuses on critical training requirements to determine which ones require a training device as a medium to promote effective learning.

2-9.1 Develop a Practice Requirement Index (PRI)

The Practice Requirement Index (PRI) per task is the product of the ratings assigned by the SMEs to the following task characteristics: "Delay Tolerance" in performing the task; "Task Performance Difficulty" in the operational situation; and the "Amount of Practice Required" to maintain a desired level of proficiency. This index provides an indication of the extent to which initial practice and sustainment training is required to establish and maintain an acceptable skill level in task performance.

2-9.2 Establish a PRI Cut-Off Point

The PRI is used to screen the tasks constituting critical training requirements to identify those tasks which warrant further analyses to determine the requirements for a training device. Based on the meaning of alternative PRI values, a minimum PRI value is selected as a cut-off point. The cut-off point is used to eliminate from further consideration those tasks which are not deemed to present a sufficient practice requirement to warrant development of a training device. Tasks having a PRI value at or above the cut-off point are then further analyzed to determine if they do indeed present a training device requirement.

2-9.3 Perform a Skills Analysis

It is generally conceded that training devices are more essential to the development of some skills (e.g., continuous perceptual motor skills) than others (e.g., procedural skills). A skills taxonomy is developed and all tasks screened through the PRI are then analyzed to identify the kinds of skills required to perform the task.

2-9.4 Analyze Tasks against Other Characteristics

Tasks remaining after the PRI screening are then further evaluated against a combination of three criteria:

- Identified skills
- Job aids provided to perform the task
- Conditions affecting task performance

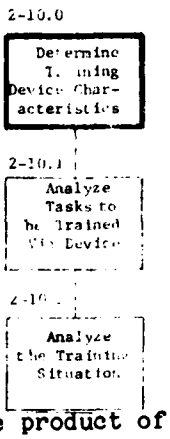
The objective is again to eliminate any tasks not requiring equipment as a training medium.

2-9.5 Analyze Tasks against Other Training Media

As a final check to assure that the remaining tasks do indeed require equipment as a medium for training, the trainability of these tasks by media other than devices/equipment is evaluated. The tasks remaining after this evaluation enter the final stage of analysis, the determination of essential training device characteristics. These tasks become the primary focus of the Training Device Requirement document (TDR).

2-9.6 Identify Type(s) of Coordination

Prior to entering the final stage of the analysis, all remaining interactive tasks are analyzed to identify the types of coordination involved during performance of the task. Information regarding the kind of coordination involved in performing operator interactive tasks provides inputs to definition of the structure of the learning situation and to determination of the physical characteristics of the trainer.



2-10.0 Determine Training Device Characteristics

The final step is to determine the physical and instructional characteristics of the device(s) relative to the site(s) that will utilize the device as a training medium. The physical characteristics of the device pertain to "What" must be simulated in order to learn the skills required to perform the tasks in the operational situation, i.e., on-the-job. Instructional characteristics are those features of the training device that promote the learning process and facilitate the instructor's role in the training situation. The inputs to this analysis are the descriptions of those tasks identified as requiring a device as a medium (the product of step 9); the task and training data developed for the sites at which that task will be given primary and secondary training (the products of step 6 and 7); and descriptions of man-machine interfaces (system equipment) (step 1). Training device characteristics are identified by the training developer and are used as inputs to the TDR and the specifications for the devices, and also as inputs to the conduct of the cost and training effectiveness analysis.

2-10.1 Analyze Tasks to be Trained via Devices

The task data and the descriptions of the man-machine interfaces are analyzed to determine what physical characteristics the training device must have. The result is a listing of the conditions that must be simulated, the inputs required to the trainee, and the equipment required at the trainee station.

2-10.2 Analyze the Training Situation

The training data for the site at which the task will be trained are the primary determinants of the instructional characteristics along with the application of learning principles that have demonstrated their effectiveness in promoting training. Training data per site are analyzed to identify the following:

- Type of training (primary/secondary)
- Instructor/trainee ratio
- Facilities

Training device characteristics that have been demonstrated as being effective in promoting the learning process include, but are not limited to, the following:

- Provision to start, stop and reposition the training exercise at any point in time

- Pre-programmed training problem exercises
- Training problems graduated in terms of difficulty
- Knowledge of results (KOR)
- Objective and diagnostic measures of training performance.

The appropriateness of these and other instructional characteristics are evaluated for inclusion in the device.

3.0 HOW TO DO IT

Overview

Section 2.0 stated what has to be done in the development of task descriptions and the analysis of these task descriptions to define critical training requirements, the tasks which require equipment/device support for training, and the characteristics required of the equipment/devices to support training.

This section presents how you, the training developer, should go about doing these things. It includes the detailed steps in the development of task descriptions and in the several analyses of these tasks to define the training equipment/devices.

Again the major components of the methodology are:

- Development of accurate and comprehensive Task Descriptions
- Analysis of Tasks to determine Training Requirements
- Identification of those Tasks which require Training Equipment to support Training
- Determination of the characteristics of Equipment/Devices required to support training of the selected Tasks.

How to perform the steps needed to accomplish these components is presented in this section.

3-1.0 Collect System and Performance Data

Training devices may be developed for new emerging systems, existing systems, or modifications to existing systems. Regardless of the state of system development, the training developer must obtain and review data regarding the system's missions and goals, functional and operational requirements, and the design requirements in terms of the equipment and personnel provided to control, operate and maintain the system in its operational context. This initial step is crucial, for these data form the base for the performance of subsequent steps. The products of these steps will be only as good as the data that go into them.

3-1.1 Prepare a Data Recording Form

Prior to initiating any data collection activities, set up a data collection form that encompasses the kinds of information required to describe and analyze human performance in the system. Organize the data sheets by mission phase with column headings as shown in the sample in Figure 2.

Most military missions can be divided into the following phases or segments:

- Plan
- Prepare
- Move
- Perform (mission objectives)
- Post Operations
- Emergency and contingency operations (occur in any of the above mission phases)

This breakdown of a military mission is generic and can be applied to any type of soldier-machine system. However, the training developer will find that the user will often establish a set of mission segments or phases that are unique to the system under study. As for example, for the mission phase "move", an aircraft system would use "enroute"; an infantry system "movement to contact"; and an artillery system "displace" or "transit" to position areas. Regardless of the title, the phase selected should have a logical start and finish point. It should occupy an exclusive time interval within the mission, and all phases when taken together should describe the entire mission. The first column in

Mission Phase: Movement to Contact

System Activity	Design Requirements	Performance Requirements and Standards	Operational Environment (Internal/External)	Personnel Allocated	Comments . Safety . Emergencies . Hazards . Job Aids
Prepare vehicle for fording	. Fwd and aft bilge pump indication lights dim if pumps jam . Accessible drain plugs . Ability to close aft vent fuel cap	. Stop engine and set handbrake (D) . Crawl under vehicle and check that four drain plugs are in place. Tighten if necessary. (FPWO) . Prepare bilge pumps (D)	External . Day, night and periods of low visibility . Extreme weather - Rain - Snow - Sleet Internal . Normal or blackout lighting	Driver (D) and any one of six Firing Port Weapon Operators (FPWO)	. Engine must be off and handbrake set before crawling under vehicle

Data Source: DEP-FMC

Figure 2. Sample Data Recording Form for System and Performance Data Requirements Identification (page 1 of 2).

Mission Phase: Movement to Contact

System Activity	Design Requirements	Performance Requirements and Standards	Operational Environment (Internal/External)	Personnel Allocated	Comments . Safety . Emergencies . Hazards . Job Aids
		. Close aft fuel vent cap (FPWO) . Prepare vehicle in 60 secs. after start			

Figure 2. Sample Data Recording Form for System and Performance Data Requirements Identification (Page 2 of 2)

the Data Recording Form (Figure 2) identifies the activity that the system is required to accomplish. Assign a different number to identify each activity and to facilitate the later organization of activities into functions, tasks, and task steps and elements. Identify in which phase or phases of the mission the activity is performed. Enter this information at the top of the data form. Since the collection of data is a continual process with information being obtained from a variety of sources, maintain a separate data record sheet(s) for each system activity identified. At the bottom of the data form, identify the source or sources from which the data was obtained to describe that system activity.

The design requirements (Column 2) identify what is being provided to perform the system activity. Under Column 3 identify how the activity is to be performed in the operational environment and the minimum acceptable standard or criterion required in the performance of the activity. In Column 4, describe the operational environment under which the activity is performed. This involves listing the ambient condtions, both internal and external to the system, that will exist during the performance of that activity. Under the column heading "Personnel Allocated," identify the operator or operators assigned to perform the activity. The final column is a "catch-all" to record additional characteristics of the activity that will affect how the activity is designed and how it is performed in the operational environment.

3-1.2 Obtain Data from Sources

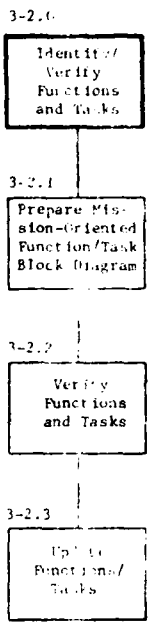
The primary sources for the collection of system and performance data are system documentation; SMEs in the operational commands, materiel development agencies, and the proponent school; design reviews; and system/subsystem tests and evaluations. For an existing system, the latter source of data is augmented by direct observations of system performance during tests.

3-1.3 Review and Collect Additional Data

System documentation is the first source of data to be reviewed. This review familiarizes the training developer with the system's design and functional requirements and provides a framework within which data voids can be identified. Once the data voids have been identified, contact SMEs to obtain additional inforation. Contact the SMEs prior to any meetings or interviews and make them aware of your specific needs. Take the opportunity during these meetings to verify already collected data and to identify the time and place of design reviews and tests that could provide additional system and performance data.

3-1.4 Complete Data Recording Forms

Assemble the data and complete the data recording forms. These forms, the system data, and the knowledge built up from the data reviews constitute the base for performance of several subsequent steps.



3-2.0 Identify/Verify Functions and Tasks

A function is a definite action that the system is required to perform during a mission in order to attain the objectives and goals for which is was designed. Functions are generally described in a verb-noun phrase to identify "What" the system is designed to do, e.g., "Engage Targets." A function is comprised of tasks which describe "What Must Be Done" in order for the system to accomplish a function. As for example, in order for the system to accomplish the function "Engage Targets," it would require performance of such tasks as Detect Target, Identify Target, Classify Target, Calculate Range to Target, Select Weapon, etc. Figure 3 is a task hierarchy used to structure the development of mission-oriented task descriptions within a mission phase and function context. System functions and tasks are identified in this step and then verified to ensure their accuracy and completeness prior to proceeding to step 3.

The specific system documentation used as sources of information regarding system functions and tasks are mission profiles, scenarios, and function analysis data generated by the materiel developer; and the completed data recording forms from step 1. The mission profile is a graphical plot of the system as it progresses through various segments of a mission against time. The scenario, most often developed from the profile, is a detailed narrative of a mission describing the system functioning against threats and other critical events such as failure modes and emergencies. Both mission profiles and scenarios are used as data inputs to the functional analyses performed by the developer during system design and development. This analytical process starts with identification of the system's top level functions (i.e., major events occurring in the mission) and successively breaks down each function into more specific levels of detail that identify "What To Do" in order to accomplish the top level function. Function analysis data are used to determine system requirements, perform trade-offs between functions and to allocate the performance of functions between equipment, human operators and combinations thereof. Most function analyses, except those carried to lower and more detailed levels, do not indicate operator, equipment or software allocations. Human factors engineering analyses data such as requirements allocation sheets, opertional sequence diagrams, decision/action charts, link diagrams and others are reviewed to get more detail regarding allocation of tasks and how tasks are performed.

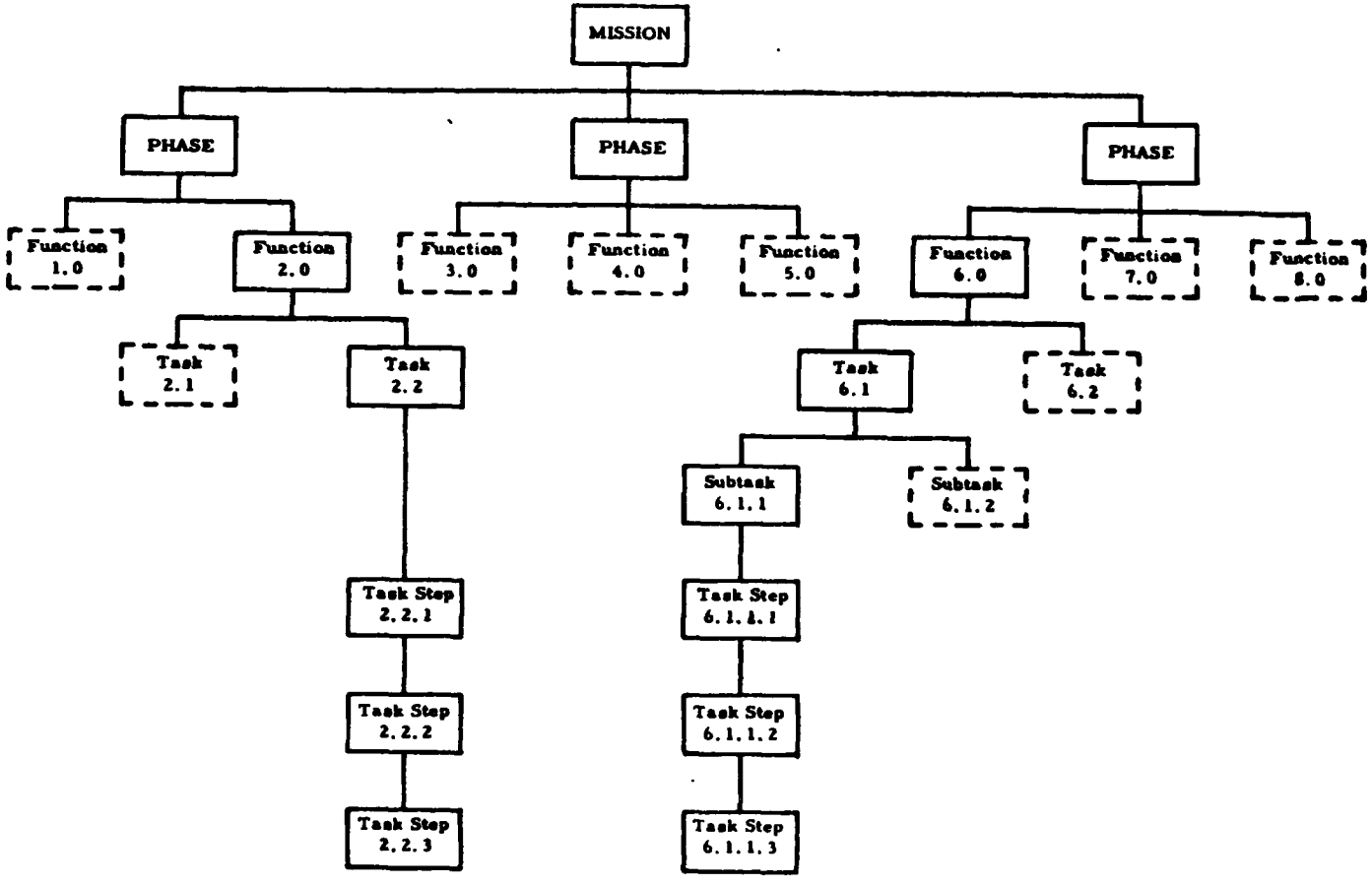


Figure 3. A Task Hierarchy for Structuring the Development of Mission-Oriented Task Descriptions.

The first requirement in this process is to review all of the above data to determine if Steps 2 and 3 have already been adequately done. If, after review, the existing documentation is judged adequate, you can proceed to Step 4. However, more often than not, you will probably find that Steps 2-5 need to be performed in part at least and perhaps completely. The most common deficiency will be incomplete function and task listings and descriptions with respect to operations (e.g., tactical) other than equipment control per se.

3-2.1 Prepare a Mission-Oriented Function/Task Block Diagram

The mission-oriented function/task block diagram describes the functions the system must accomplish during each phase of a mission and the tasks that are performed to accomplish the function. It is prepared as a working tool and used by the training developer as a basis to identify and prepare descriptions of the tasks that are required to perform the function. The basic input to development of the diagram are the system activities recorded during the collection of system and performance data (Step 1) and the above noted system documentation. An example of a mission-oriented function/task block diagram appears in Figure 4. The following steps describe how to prepare such a diagram:

- Identify the mission phases and list them sequentially and across the top of the diagram.

- From the data recording sheets (Figure 2) list the major functions occurring in each phase of the mission. Describe the function in a verb-noun phrase, represent it in a single box and number it for later reference, using a decimal system such as 1.0, 2.0, 3.0, etc.

- Under each function, list the tasks (activities on the data recording sheet) that must be performed by operators and operator/equipment combinations in order to accomplish the function. List them vertically and sequentially in their expected order of occurrence. Number them following the decimal system, e.g., under the function numbered 2.0, the tasks will be numbered 2.1, 2.2, 2.3, 2.4, etc. (Do not list activities that describe "How" the task is performed at this point. This is a subsequent step (Step 3).)

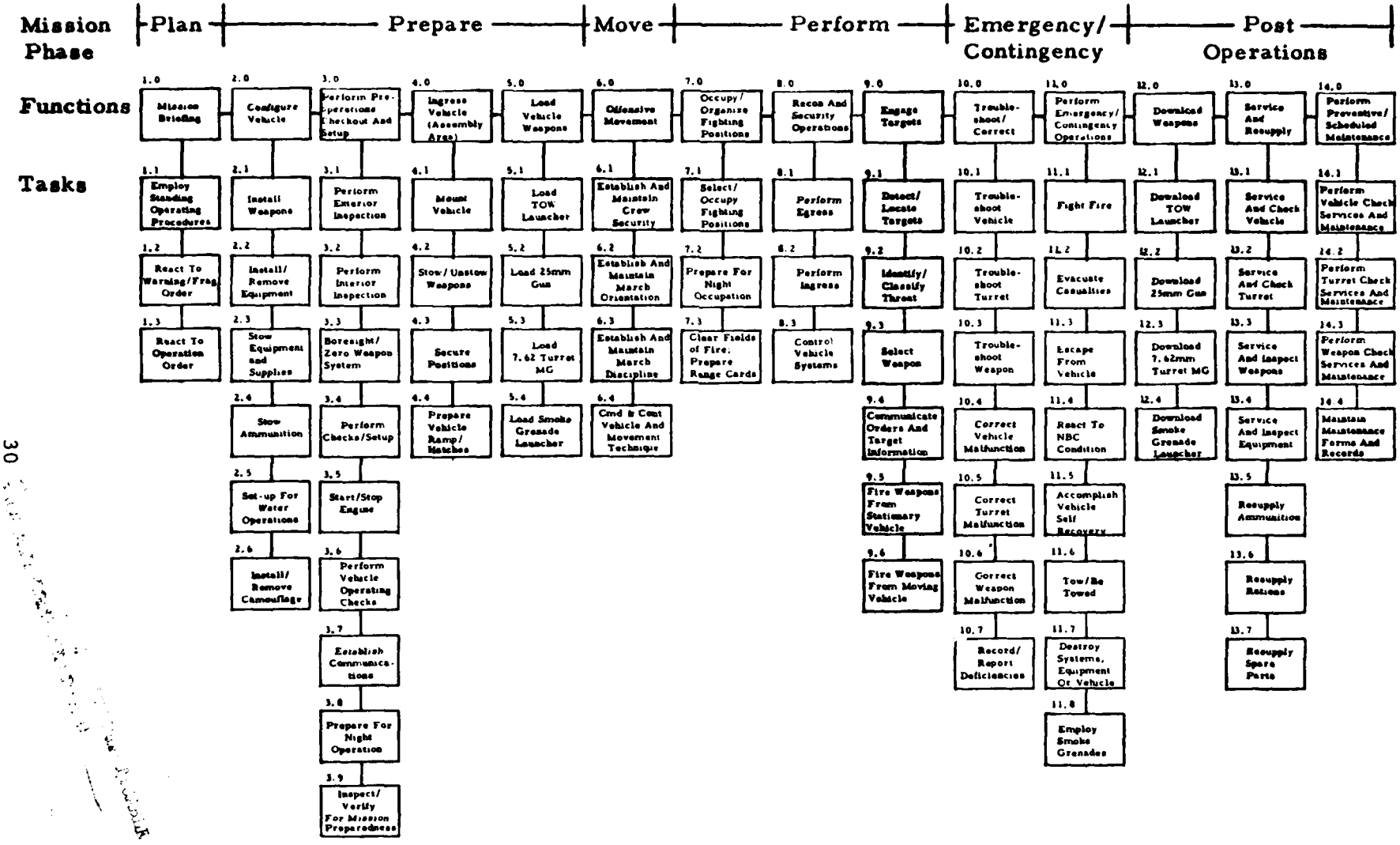


Figure 4. Example of a Mission-Oriented Function/Task Block Diagram.

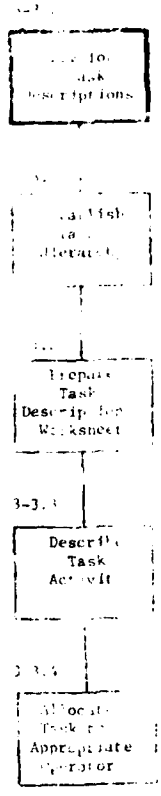
o After completing your organization and numbering of functions and tasks, revert to data recording forms and insert the numbers as appropriate. This provides a cross-reference as you proceed with the descriptions and analyses of tasks.

3-2.2 Verify Functions/Tasks

System functions are verified by submitting the mission-oriented function block diagram for review by SMEs in the operational commands, proponent schools and/or the materiel developer's organization. The verification process is expedited by submitting the mission-oriented function block diagram to SMEs organized into a group, with you, the training developer, as the discussant. Using the diagram, walk through each phase of the mission and have the SMEs verify the functions and subfunctions identified, their occurrence in the mission and sequence of performance, and request that they identify any additions, deletions or changes. This gathering of SMEs also presents an opportunity to verify the additional system and performance data collected and recorded on data sheets and to request their assistance in filling in the gaps or recommending sources for obtaining the missing information.

3-2.3 Update Functions/Tasks

Update the mission-oriented function block diagram to reflect the recommended additions, deletions or changes made by the SMEs. The structure of the block diagram permits these changes to be made easily. The system and performance data recording sheets also are updated accordingly.



3-3.0 Develop Task Descriptions

A frequent source of confusion existing among practitioners in the training community is the difference between a task description and a task analysis. A task analysis should be viewed as the sum of the techniques used by the analyst to identify, describe, verify, and classify those tasks performed by personnel to accomplish the operational and maintenance functions of the system. These analytic techniques vary in format of presentation, content and degree or levels of detail of task information.

Task description is basically an analytic technique that further breaks down the tasks into activities (task steps) that must be performed in order to accomplish the tasks. The product describes "How" the task is performed in terms of the actions required to accomplish the task.

3-3.1 Establish a Task Hierarchy

A task hierarchy for structuring the development of mission-oriented task descriptions is shown in Figure 3. The identification of system functions performed during each phase or segment of a mission and the tasks required to accomplish each of the functions has been discussed (cf., 3-2.1). The next lower level in the hierarchy is the "Task Steps" that describe "How" the operator proceeds to accomplish the task. These task steps contain the elements comprising the task consisting of: 1) inputs (stimuli, cues) required to initiate the task; 2) decisions that are made as a result of processing the inputs; 3) actions taken and any equipments that are acted upon; and 4) feedback to the opertor as a result of the action. Tasks described to this level permit the identification of the knowledges and skills required to perform the task, the subjects of interest to the training developer.

Function 6.0 in Figure 3 interjects an additionl level in the hierarchy by breaking up Task 6.1 into subtasks. This is done at the discretion of the analyst for those tasks that are complex and require a significant amount of operator activity or contain more than one group of activities performed sequentially or independently to accomplish a common task objective. Tasks are broken down into subtasks only when necessary to provide manageable units for later analyses.

3-3.2 Prepare a Task Description Worksheet

Narrative task descriptions are prepared for use in subsequent task analyses: these must encompass the actions of the human in operational terms that are characteristic of, and appropriate to, the system. The task

description contains a sequential listing of operator activities (steps) that describe the actions and the equipment acted upon, the conditions under which the task is performed and the operator or operators performing the task. A worksheet, like the sample shown in Figure 5, is prepared to organize and describe the elements of a task description.

The use of the task description worksheet is illustrated by Figure 5. This figure describes one of the tasks performed by an armored vehicle, the IFV, operating in a mission context to accomplish Function 9.0 - "Engage Targets." The task number is 9.5 - "Attack Stationary Target with 25mm Gun." The conditions under which the task is performed are described adjacent to and below the task statement. In the column labeled "Task Step Description" are the actions or activities performed to accomplish the task. These steps are numbered sequentially such as: 9.5.1, 9.5.2, 9.5.3, etc.

It will be noted that one of these steps (9.5.6) is further described in terms of several substeps (9.5.6.1, etc.). In deciding what level of detail is necessary, the criterion is to describe the task to that level necessary to understand how the task is actually performed. The columns numbered 1-9 designate the IFV operators by seat number in the vehicle. Within each column and opposite each task step (action or activity) a number/letter coding system is used to identify the crew member(s) assigned to perform the Step. The following is the description of the coding system:

- The numeral one (1) appearing in a single operator's column indicates that the task step has been assigned and is performed by the operator in whose column the (1) appears. A one (1) appearing in more than one column (up to nine columns) indicates that the task step is performed by one man, but it may be performed by any one of the operators in whose column the one (1) appears.

- The numeral two (2) appearing in two of the operator columns indicates that the task step has been assigned to these operators and is to be performed as a time-shared task step or as a single task step to be performed simultaneously by each of two operators. The task description itself will assist in identifying which case is being addressed.

- When the numeral two (2) appears in more than two columns, the indication is that the task step can be performed by any two of the operators in whose columns the numeral two (2) appears. Numerals three (3) through nine (9) have similar meaning. However, the numeral three (3) must appear in at least three columns, four (4) in at least four columns, etc.

TASK DESCRIPTION DATA SHEET

Page 1 of 2

FUNCTION: 9.0 Engage Targets

TASK: 9.5 Attack Stationary Target with 25mm Gun

CONDITIONS: *Daytime, IFV Stationary, Turret Power On, Turret Drive On, Turret Stabilized*

Task Step	Task Step Description	Operator Position Seat Number								
		Commander	Gunner	Driver	FPW Operators					
					Left Fwd.	Left Mid.	Lt.R.(FTL)	Mid Rear	Rt. Fwd.	Rt. Rear
		1	2	3	4	5	6	7	8	9
9.5.1	Search assigned sector for target threats.	I								
9.5.2	Detects target.	1								
9.5.3	Slew turret and gun to vicinity of target using TC control stick.	1								
9.5.4	Observe target in alignment with the front center vision block and vane sight.	1								
9.5.5	Issue initial fire command, e.g., "Gunner, HE, truck, direct front 1000" (via intercom)	S	R	R	R	R	R	R	R	R
9.5.6	Respond to inital fire commands.									
9.5.6.1	Observe target in integrated sight unity window locating ring.		1							
9.5.6.2	Observe target in integrated sight at 4X power.		1							
9.5.6.3	Move gunner control handle to align target with optical reticle.		1							
9.5.6.4	Classify target - friend or foe.		1							
9.5.6.5	Select 12X power, if necessary, to make classification.		1							
9.5.6.6	Turn superelevation to the announced range.		1							
9.5.6.7	Report "Identified, Foe." (via intercom)	R	S							
9.5.6.8	Order "Fire." (via intercom)	S	R							

Figure 5. Example of a Task Description (page 1 of 2)

TASK DESCRIPTION DATA SHEET

Page 2 of 2

FUNCTION: 9.0 Engage Targets

TASK: 9.5 Attack Stationary Target with 25mm Gun (continued)

Task Steps	Task Step Description	Operator Position Seat Number								
					FPW Operators					
		Commander	Gunner	Driver	Left Fwd.	Left Mid.	Lt. R (FTL)	Mid Rear	Rt. Fwd.	Rt. Rear
		1	2	3	4	5	6	7	8	9
9.5.6.9	Press "HE SS." (Rate of fire depends on SOP)		1							
9.5.6.10	Observe "HE SS" indicator ON.	2	2							
9.5.6.11	Place master ARM/SAFE switch in ARM.		1							
9.5.6.12	Observe "ARM" indicator ON.	2	2							
9.5.6.13	Announce "On the Way." (via intercom)	R	S	R	R	R	R	R	R	R
9.5.6.14	Squeese trigger.		1							
9.5.6.15	Observe effect on target.	2	2							
9.5.6.16	Report sensing of burst on target. (via intercom)	R	S							
9.5.6.17	Announce sensings and correction, if appropriate. (via intercom)		1							
9.5.6.18	Apply corrections, if appropriate.		1							
9.5.6.19	Fire single shot, HE, until TC orders "Cease Fire."		1							
9.5.6.20	Order "Cease fire." (via intercom)	S	R							
9.5.6.21	Place master ARM/SAFE switch in SAFE.		1							
9.5.6.22	Observe "SAFE" indicator ON.	2	2							
9.5.7	Report target destruction/evaluation per SOP (via radio).	S								

Figure 5. Example of a Task Description (continued). (page 2 of 2)

- Certain steps have been identified in which the number of operators performing the step simulataneously may vary because of the tactical situation. These have been identified by indicating the range of possible operators involved across a number of position columns. For example, "1-6" across columns four (4) through nine (9) indicates that the task step may be performed by any number between one (1) and six (6) of the Firing Port Weapon Operators (FPWO).

- Communication tasks are indicated by the letter "S" for sender and "R" for receiver. The letter "R" appears only in the column of the operator being addressed even though other operators may hear the order through their intercom sets. The letter "S" appearing in more than one column indicates that the communication task may be performed by any one or all of the operators in whose column the letter "S" appears. The task description identifies the means of communiction, i.e., radio, intercom, hand-arm signals, and direct voice (face-to-face).

3-3.3 Describe Task Activity

Each step required to perform the task is described in action terms and, taken collectively, describe "How" the task is performed from initiation to completion (see Figure 5). Examples of task step statements are: "Observes target in reticle of integrated sight"; or , "Slews turret using joystick control and observes target aligned on crosshairs." These statements contain task elements which are the subject for further analyses to determine training requirements, training device requirements and training device characteristics.

For a new emergent system, the primary source for describing tasks to the element level is the documentation generated by human factors engineering personnel involved in design and development of the system. Other sources are DEPs, FMs, TMs, mock-ups, tests and SMEs who are knowledgeable about the system under development or have experience with existing systems performing similar tasks.

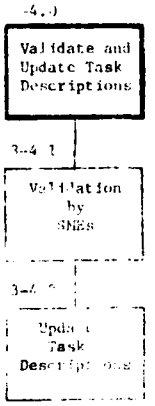
3-3.4 Allocate Task Steps to Appropriate Operator(s)

The task steps must be allocated to an operator or operators. For new systems, allocation of functions to operators, equipment, combinations thereof and to software follows the analysis of functions and system operational requirements. The results of the allocation process are generally

documented and are available to the training developer who records this information during the collection of system and performance data (see Figure 2). Allocations are monitored through "Design Freeze" and are updated to reflect any reallocations made as a result of tests and evaluations or, of further analyses of individual and crew workload. Other system documentation, such as the Materiel Needs Document, also may identify "Who" in the system will perform the task. These allocations are generally based on experience with systems performing similar functions and tasks.

Recording of the allocation of task steps to appropriate operators on the Task Description Worksheet is shown in Figure 5 and described in paragraph 3-3.2. Allocation data presented in this manner facilitates the organization of system task descriptions by individual operator position and identifies individual and team tasks. The latter are inputs to subsequent analyses to identify the type of coordination involved in performing a task, a determinant of training device characteristics.

3-4.0 Validate and Update Task Descriptions



System task descriptions, encompassing all of the operator's (crew/team) job requirements in an operational mission environment, are the data base for developing effective instructional materials. The task descriptions must be comprehensive and accurate to ensure that the training to be provided is relevant to the mission rather than training simply for training's sake. Validation of task descriptions ensure that the task steps are properly allocated; that no tasks or task steps are omitted; and, that the task steps are accurate and logically sequenced.

3-4.1 Validation by Subject Matter Experts

The development of comprehensive task descriptions for system operators performing in an operational mission environment often results in a voluminous amount of data. The most expedient and efficient way of validating task descriptions is by submitting them to SMEs in the operational command, proponent school and the materiel developer's organization for review. This should be followed up with personal interviews to discuss and collect their corrections, additions and deletions. A reviewer's data form, like the sample shown in Figure 6, is forwarded with the Task Descriptions for the SME to record his comments.

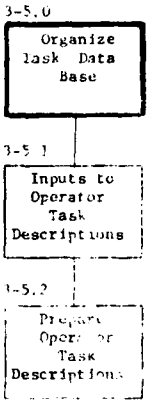
3-4.2 Update Task Descriptions

The SME comments collected on the data recording form are used to update the task descriptions. The updating process should continue for new systems under development that have not reached design "Freeze" for production. However, following the validation of task descriptions, the training developer proceeds with the task analysis and monitors and evaluates any system modifications for their impact on operator tasks and training decisions.

Reviewer's Name and Location: Task No. and Title:		
Add	Delete	Change

Figure 6. Sample of a Reviewer's Task Description Data Recording Form for Corrections, Additions and Deletions.

3-5.0 Organize Task Data Base



The validated system task descriptions identify the functions that are performed during a typical mission in an operational environment and describe the operator tasks required to accomplish the functions. Atypical events such as emergencies, contingencies and equipment malfunctions that could occur during a mission are identified and the functions and operator tasks involved to counter these events also are described. These tasks now must be organized by operator position (i.e., the individual operator(s) involved in performing the tasks) in order to conduct subsequent task analyses to determine training requirements and training device requirements for each of the system's operators.

3-5.1 Inputs to Operator Task Descriptions

The Validated System Task Description Data Sheets (Figure 5) provide the inputs to this step. Data from these Task Description Data Sheets are transcribed onto Task Data Forms (Figure 7). The result is a set of forms per operator that describe all the tasks performed by him, are nonredundant in that description (i.e., similar tasks are described only once), and make note of any interaction with other operators. The data that are transcribed from the Task Description Data Sheets onto the Task Data Forms include:

- Identification (title) of the operator performing the task
- Task number, statement and task steps
- Identification of interactive operators in team tasks

3-5.2 Prepare Operator Task Descriptions

The organization of tasks by operator position starts by recording the operator's position title at the top of the Task Data Form (Figure 7). Using the system Task Description Data Sheets and starting with Function 1.0, identify and record by number and title the first task in which that operator performs. Below the task title, list the task steps that are performed only by the operator identified at the top of the recording form. Other operators involved in performing the task are identified by code and recorded in the column titled "Interactive Operators" on the Task Data Form. Proceed through Function 1.0 and record each task for that operator on a separate Task Data Form. Follow the same procedure for the other operators involved in performing tasks in Function 1.0 then proceed to Function 2.0 and succeeding functions and repeat the entire procedure.

Similar tasks performed by the same operator may appear in more than one function. When this occurs, examine the task steps and if they are the

TASK DATA FORM

Operator Position Gunner

Task No., Title and Task Steps	Criticality 0-3	Task Newness 0-3	Performance Difficulty 0-3	Delay Tolerance 1-2	Frequency: Combat 1-4	Frequency: Practice Required 1-4	Conditions Affecting Performance 1-11	Job Aids 0-1	Performance Measures/Standards	Training Site: 1-3: Primary	Training Site: 1-3: Secondary	Interactive Operators* 1-7	Coordination Type* 1-2	Skills* 1-5
9.5. Attack Stationary target with 25mm gun, HE An example of the task steps that are required by the Gunner are shown on page 44.	3	3	2	2	4	3	1, 5	0	Target hit within third burst and within _____ seconds after detection	1	2, 3	1	2	2, 4

* To be completed by analyst

Figure 7. Sample of a Task Data Form Used for Recording Task Evaluator Responses During the Task Analysis.

same as a previously listed task, record the task number only on a separate sheet or on the Task Data Form as an indication of the frequency that the task is performed during a typical mission. This information is needed during the task analysis to assist the task evaluators in making judgments regarding the criteria of "Frequency of Task Performance in Combat" and "Frequency of Practice Required to Maintain Proficiency." Similar tasks may require that the operator perform differently because of a change in system or external conditions. For these occurences, the "changed" task and task steps are added to the operator's task description.

To illustrate the basic steps in the process of organizing tasks by operator position, reference Figure 5 for an example of a system task description. This example illustrates these task steps which must be performed to accomplish Task 9.5 "Attack Stationary Target with 25mm Gun." By referring to the column titled "Operator Position Seat Number," it is possible to identify which operator is performing the task steps required to accomplish the task. In the example cited (Figure 5) the information that is transcribed onto the Task Data Form for the operator position titled "Track Commander" is shown in Example 1, page 43 . Now assuming that all of the Track Commander's common and interactive tasks have been listed for Function 9.0, the Gunner's tasks are now listed for Function 9.0. Again as an example, refer to the Figure 5 system task description and transcribe the Gunner's task steps onto the Task Data Form as shown in Example 2, page 44 . In both of these examples, note that the task number and task title are repeated for each operator for easy referral to the system task descriptions. However, only the specific task steps performed by the operator are listed.

Example 1

TASK DATA FORM

Operator Position Track Commander

Task No., Title and Task Steps	Criticality 0-3	Interactive Operators 1-7	Coordination Type 1-2	Skills 1-5
9.5 Attack stationary target with 25mm gun, HE (Task Steps performed by the Track Commander only) • Search assigned sector for target threats • Detect target • Slew turret and gun to vicinity of target using TC control stick • Observe target in alignment with front center vision block and vane sight • Issue initial fire commands • Order fire (after Gunner has identified target as foe) via intercom • Observe "HE SS" indicator ON • Observe ARM/SAFE indicator ON • Observe effect on target • Receive Gunner sensings • Order "Cease Fire" • Observe SAFE indicator ON • Report target destruction/evaluation per SOP (via radio)		2		

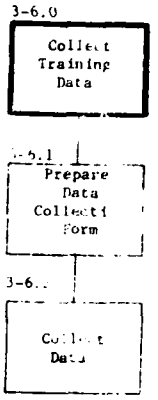
Example 2

TASK DATA FORM

Operator Position Gunner

Task No., Title and Task Steps	Criticality 0-3	Interactive Operators 1-7	Coordination Type 1-2	Skills 1-5
9.5 Attack stationary target with 25mm gun, HE		1		
• Receives (R) via intercom initial fire commands				
• Responds to initial fire commands				
- Observes target in integrated sight unity window locating ring				
- Observe target in integrated sight at 4X power				
- Move gunner control handle to align target with optical reticle				
- Classify target - friend or foe				
- Select 12X power, if necessary, to make classification				
- Turn superelevation to the announced range				
- Report "Identified, foe" via intercom				
- Receive (R) order to fire via intercom				
- Press "HE-SS"				
- Observe "HE-SS" indicator ON				
- Place master ARM/SAFE switch to ARM				
- Observe ARM indicator ON				
- Announce "On the way" (via intercom)				
- Squeeze trigger				
- Observe effect on target				
- Report sensing of burst on target				
- Announce sensing and correction				
- Apply corrections				
- Fire single shot, HE, until TC orders "Cease Fire"				
• Receive (R) "Cease Fire" order				
• Place master ARM/SAFE switch to SAFE				
• Observe "SAFE" indicator ON				

3-6.0 Collect Training Data



The training data to be collected describe the physical and human resources planned or developed for student training site(s). These data will provide inputs to a training situation analysis which contributes to the indentification of the type of device and its characteristics. In order to be effective as a training medium, these device characteristics must blend in with the overall training program and training facilities at each site and satisfy the needs of those personnel responsible for managing and conducting training.

3-6.1 Prepare Data Collection Form

A sample form to be used for the collection and recording of training data is shown in Figure 8. In addition to the data shown on this form, it is necessary to identify which site will provide primary and secondary training for each task selected for training. These latter data are collected during the task analysis and are discussed in para. 3-7.2.

Items 1-6 on the data form are self-explanatory. For Item 7, obtain a physical description of all training related facilities and materials (e.g., buildings, classrooms, student learning centers, ranges and courses). In the "Remarks" item, include information gleaned from training planning and development documentation regarding management and conduct of the training program. Included here might be such data as plans for performance measurement, scoring, record keeping, automated features, etc.

3-6.2 Collect Data

Sources of training data can include personnel involved in the development of the Individual and Collective Training Plan (ICTP), materiel developer personnel, and SMEs on similar systems. Data can be obtained through review of documentation to the extent that such has been developed. If such documentation as the ICTP has not been sufficiently detailed, it will be necessary to conduct interviews or group sessions with SMEs.

Training Data Form

1. Name and Location of Site:

2. Type: ☐ School ☐ ATC ☐ Unit

3. MOS(s) to be Trained:

4. Training: ☐ Individual ☐ Collective

☐ Both

5. Number of Students Per Class:

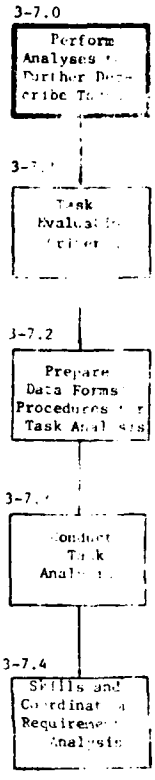
6. Number of Instructors Per Class:

7. Facilities/Materials Available:

8: Remarks:

9. Source(s) of Data:

Figure 8. Sample of A Training Data Recording Form.



3-7.0 Perform Analyses To Further Describe Tasks

It is important to keep in mind that task analysis is a process for determining particular kinds of information about the task. Merely collecting a large amount of information does not necessarily result in a good task analysis. Consequently, in this phase the training developer uses only task evaluation criteria that provide descriptive data to support selection of tasks to be trained, the identification of those tasks that require a training device and the determination of training device characteristics.

Rating scales are developed for selected task evaluation criteria so that judgments can be made regarding the amount or degree to which the properties (characteristics) of the task match the selected criteria. Task data recording forms were prepared and set up in the preceding step (3-6.0, Organize Task Data Base). These forms are now used by SMEs to evaluate the task elements (task steps) against the criteria in order to further identify and describe the characteristics of that task.

3-7.1 Task Evaluation Criteria and Scales

The following task evaluation criteria and defined rating scales (where appropriate) are used in the task analysis process to further describe tasks being performed in a mission-oriented combat environment.

- Task Criticality

  Task criticality is a measure of the effect of inadequate operator performance of the task on mission performance effectiveness. The following scale is used:

  Code 0: Non-critical - No effect on mission success

  Code 1: No important effect is evident; mission is degraded slightly

  Code 2: Mission is compromised or degraded significantly; equipment is damaged

  Code 3: Mission is aborted; equipment is damaged significantly; personnel safety is jeopardized or personnel can be injured or killed.

- Task Newness

  Task newness is a measure of the trainee's relative ability (knowledge and skills) to perform the task as a result of prior training and experience. The following scale is used to assess this criterion:

  Code 0: The task can be performed by personnel as a result of prior MOS training; no new knowledge or skills are needed and further training is unnecessary.

  Code 1: The task can be performed by the designated personnel without additional formal training; however, personnel will require on-the-job familiarization with the location, use, or installation of the equipment.

  Code 2: The task will require a relatively restricted amount of specialized formal training of individuals; the task involves standard equipment that has been reconfigured or repackaged; task requires some new tools or equipment and may require some new skills.

  Code 3: Proper task performance will require the acquisition of new skills and knowledges because of technological advances in the career field; more specialized training than that required for Code 2 must be received before personnel will be able to perform the specified activity.

- Task Performance Difficulty

  Task performance difficulty is a measure of task complexity and the adequacy of the work environment in which the task is performed. This task characteristic is evaluated using the following scale:

  Code 0: Unskilled task--requires no training or experience to accomplish.

  Code 1: Easy to perform in the operational situation--equipment and work environment adequately designed; normal ambient conditions have no effect on performance; minimal effect from normal clothing and gear.

  Code 2: Fairly hard to perform--some constraints in the operational environment; some restriction of normal clothing and gear.

Code 3: Hard to perform--the work environment, ambient conditions or the equipment design can produce major errors in task performance; normal clothing and gear restrict performance significantly.

- Task Delay Tolerance

Task delay tolerance is a measure of how much delay can be allowed between the time the need for task performance becomes obvious and the time actual performance must begin. The following scale is used to obtain data on this measure:

Code 1: Task is required but need not be initiated immediately. At least some delay time is permissable.

Code 2: Task must be initiated immediately upon receipt of information that the task is required.

- Task Performance Frequency

Task performance frequency refers to the regularity (or irregularity) with which a task is performed under combat conditions. This task criterion is rated using the following scale:

Code 1: Yearly - one to four times a year

Code 2: Monthly - one to four times a month

Code 3: Weekly - one to four times a week

Code 4: Daily - once or more a day

- Task Practice Frequency

This criterion is a standard for estimating frequency of task practice required to maintain a desired level of proficiency. The following scale is used for making these judgments:

Code 1: Yearly - one to four times a year

Code 2: Monthly - one to four times a month

Code 3: Weekly - one to four times a week

Code 4: Daily - once or more a day

- Conditions Affecting Task Performance

  Conditions are the circumstances under which the task is performed. The conditions affecting task performance that are of concern in the analysis are those that impinge on an operator's sensory, mental or motor processes so as to increase the difficulty of performing some or all of the task steps required in the task. As, for example, restrictions in visibility reduce the probability of target detection; increased workload, such as multiple targets, create stress that could affect the operator's mediating process; or, workspace or personal equipment and clothing restrictions affect speed and/or accuracy of the response (action) taken to produce an output.

  Conditions under which the task is performed are identified in sytem documentation such as materiel needs, specifications and tactical doctrine and through discussion with SMEs experienced with similar systems and conditions of operation. These conditions are categorized and subjected to evaluation during the task analysis by having SMEs identify no more than four (4) conditions that will seriously affect performance of the task being analyzed. A sample of conditions affecting performance of tasks in a weapons system operating in a combat environment is shown below:

Conditions Affecting Performance

Select no more than four (4) of the following types of conditions which most affect task performance:

Code 1: Restricted visibility (periscope and sight limitations, darkness, fog, smoke)

Code 2: Noise (internal and external to vehicle)

Code 3: Moving vehicle (acceleration, deceleration, rough terrain)

Code 4: Temperature/humidity extremes (hot, cold, humid, dry)

Code 5: Extreme weather (snow, rain, sleet)

Code 6: Type of terrain (desert, mountain, built-up)

Code 7: Multiple targets

Code 8: High communication load

Code 9: Workspace restrictions (control and equipment access, crowding)

Code 10: Personal equipment and clothing (gloves, helmets, masks)

Code 11: In contact with enemy

- Job Aids

Job aids include manuals, schematics, checklists, procedures, nomographs, mnemonics and other devices provided to assist operations on-the-job in performance of tasks. These aids are produced during system design to improve operator effectiveness, reduce task workload and to minimize the need for training or the amount of training. Data regarding the availability of job aids in the operational situation is obtained during the task analysis by having SMEs indicate the presence or absence of a job aid to assist in performing the task being analyzed. The following categories are used when analyzing each task:

Code 0: No job aid provided

Code 1: Job aids provided

- Task Performance Measures/Standard

A performance standard is a statement of the minimum acceptable proficiency required of an individual or team in the performance of a task. Examples of performance standards might be "Reload two missiles within 50 seconds," or, "a hit probability of .7 to .9 shall be attained at ranges of 1000 to 2000 meters with no more than 12 rounds of ammo within a time limit of 9 to 12 seconds." Statements such as these provide measures of performance or task output. They have been identified to some extent during earlier review of the system's requirements, specifications and operational documentation, and were recorded on the system and performance data forms (see para. 3-1.1 - 3-1.4). Additional information may be obtained during this analysis step from SMEs.

For new or modified systems having new tasks, performance standards may not have been established. Those task performance standards that have been identified during the review of system documents and interviews with SMEs are verified during the task analysis. Where voids occur, the task is analyzed to identify objective measures that can be used to assess performance of that task without specifying the minimum proficiency required, e.g., "Detect targets in assigned surveillance aea within X seconds

after target enters area;" or, "First round target hit within X seconds after fire command."

- Site of Task Training

  During the task analysis process, judgments are made by SMEs regarding which of the training sites will provide the primary and secondary training for each task. Primary is initial task training; secondary is transitional or reinforcement task training. These data are used in conjunction with other training data (see para. 3-6.1) to determine training device characteristics. The following training sites are identified as potentially providing primary and secondary training for the task being analyzed:

  Code 1: School

  Code 2: Army Training Centers

  Code 3: Unit

3-7.2 Prepare Data Forms and Procedures for Task Analysis

The data forms to be used in the task analysis are shown in Figure 7 and Table 1. The Task Data Form (Figure 7) contains a description of the task to the most detailed level (accomplished in Step 5) and identifies the criteria against which the task or task steps are to be evaluated. Definitions of the rating scales, categories and codes for task evaluation criteria (see section 3-7.1) are shown in Table 1 and are used with the Task Data Form to assist the raters in forming their judgments and responses. The digital coding system assigned for responses to each of the criteria provides for ease of tabulating and summarizing the task analysis data either manually or by computer.

The rater's responses are made at the task level if this is the most detailed level of description. If more detailed levels of description are provided then ratings may be made at the task step level using the detailed descriptions as input to the rating. The ratings are entered on the data recording form under each criterion and in line with the task/task step number and title. If a computer is used for tabulating and summarizing the task analysis data, the task number is used as an identifier.

Completion of columns 1-11 in the Task Data Form is performed by SMEs following the guidelines provided in section 3-7.3. Completion of the 12th column was described earlier in section 3-5.2. The last two columns on the Task Data Form are completed by the training developer/analyst and are discussed in 3-7.4.

Table 1. Definitions, Categories and Codes for Task Evaluation Criteria Used in the Analysis of Tasks (Column Numbers Relate to the Task Data Form in Figure 7) (page 1 of 4)

Column 1 Task Number, Title and Task Steps

Column 2 Task Criticality - If the task is not performed correctly, the following levels of mission performance effectiveness will result:

Code 0: Non-critical - No effect on mission success

Code 1: No important effect is evident; mission is degraded slightly

Code 2: Mission is compromised or degraded significantly; equipment is damaged

Code 3: Mission is aborted; equipment is damaged significantly; personnel safety is jeopardized or personnel can be injured or killed

Column 3 Task Newness

Code 0: The task can be performed by personnel as a result of prior MOS training; no new knowledge or skills are needed and further training is unnecessary

Code 1: The task can be performed by the designated personnel without additional formal training; however, personnel will require on-the-job familiarization with the location, use or installation of the equipment

Code 2: The task will require a relatively restricted amount of specialized formal training of individuals; the task involves standard equipment that has been reconfigured or repackaged; task requires some new tools or equipment and may require some new skills

Code 3: Proper task performance will require the acquisition of new skills and knowledges because of technological advances in the career field; more specialized training than that required for Code 2 must be received before personnel will be able to perform the specified activity.

Column 4 Task Performance Difficulty

Code 0: Unskilled task--requires no training or experience to accomplish

Code 1: Easy to perform in the operational situation--equipment and work environment adequately designed; normal ambient conditions have no effect on performance; minimal affect from normal clothing and gear

Code 2: Fairly hard to perform--some constraints in the operational environment; some restrictions of normal clothing and gear

Code 3: Hard to perform--the work environment, ambient conditions or the equipment design can produce major errors in task performance, normal clothing and gear restrict performance significantly

Column 5 Delay Tolerance

Code 1: Task is required but need not be initiated immediately; at least some delay time is permissable

Code 2: Task must be initiated immediately upon receipt of information that the task is required

Column 6 Task Frequency - Expected frequency of task performance under combat conditions and estimated frequency of task practice required to maintain the specified level of proficiency.

Code 1: Yearly - one to four times a year

Code 2: Monthly - one to four times a month

Code 3: Weekly - one to four times a week

Code 4: Daily - once or more a day

Column 7 Conditions Affecting Performance - Identify no more than four (4) of the following types of conditions which will most affect task performance:

Code 1: Restricted visibility (periscope and sight limitations, darkness, fog, smoke)

Code 2: Noise (internal and external to vehicle)

Code 3: Moving vehicle (acceleration, deceleration, rough terrain)

Code 4: Temperature/humidity extremes (hot, cold, humid, dry)

Code 5: Extreme weather (snow, rain, sleet)

Code 6: Type of terrain (desert, mountain, built-up)

Code 7: Multiple targets

Code 8: High communication load

Code 9: Workspace restrictions (control and equipment access, crowding)

Code 10: Personal equipment and clothing (gloves, helmets, masks)

Code 11: In contact with the enemy

Table 1 (page 4 of 4)

Column 8 — Job Aids - Manuals, schematics, checklists, procedures, etc., provided for use by the operators in the operational situation.

Code 0: No job aids provided

Code 1: Job aids provided

Column 9 — Performance Measures/Standard - Statement of the minimum acceptable proficiency required of an individual or team in the performance of the task. (If the acceptable proficiency level is unknown, state the measure for task output, e.g., "First burst on target within ____ seconds of command to fire.")

Column 10 — Training Sites - Primary - Secondary Training - Identify which of the sites listed below will provide primary (i.e., initial task training) and secondary (i.e., transitional or reinforcement task training) training for each task.

Code 1: Schools

Code 2: Army Training Centers

Code 3: Unit

Column 11 — Task Interactivity - Identification of other operator positions involved in the task (to be completed by the analyst based on the review of system task descriptions)

Column 12 — Coordination Type - To be completed by analyst (para. 3-7.4)

Column 13 — Skills - To be completed by analyst (para 3-7.4)

3-7.3 Conduct Task Analysis

The type and quantity of personnel available to act as evaluators for the task analysis are governed by the state of development of the system under study. For existing systems, job incumbents and instructors are used. For new systems, the availability of personnel knowledgeable in the system and tasks being performed is limited. On these occasions, evaluators for the task analysis are obtained from the operational commands, materiel developer, and/or the proponent school. Evaluators should be personnel involved in the development and acquisition of the new system and those who have the knowledge and prior experience in systems with functions and tasks similar to those to be performed by the new system. Prior to the actual task analysis, the training developer should contact cognizant departments within TRADOC and the proponent school for any task data available from other ISD activities that could be used as input to decisions regarding tasks to be trained, training device requirements and training device characteristics.

The task analysis is conducted using structured interviews with the task evaluators grouped according to their functional area(s) of expertise, e.g., tactics, weapons, maintenance, etc. The evaluators provide ratings on task criteria for only those tasks/subtasks falling within their specific area of expertise. The size of the groups should be no less than three (3) and no more than seven (7) with each group interviewed separately by the training developer or task analyst. Each task evaluator is provided with copies of the Task Data Forms (Figure 7) prepared in step 5 pertaining to his area of expertise and the definitions of the task evaluation criteria, rating scales, and codes to be used for evaluating tasks and recording responses (Table 1). The interviewer begins the process by stating the objectives of the analysis and the procedures that will be followed during the interview. The structure and content of the Task Data Form are described and the task evaluation criteria and rating scales elaborated to insure uniform interpretation and understanding. The mission-oriented function/task block diagram (Figure 4) is presented and the contents described to provide the evaluators with an overview of the mission context and task sequences.

Given that the task (x.x), task step (x.x.x), and task substep (x.x.x.x) descriptions are at the levels of detail exemplified by the contents of Figure 5 and that the presence of step and substep levels varies across tasks, the interviewer should begin by addressing each task on the Task Data Forms individually and in sequence, to provide an overview of each functional area. If the description is provided only down to the task level, then the SME group should discuss each individual task. If, however, descriptions are provided at the task step level or below then the SME's must discuss the task steps, each one taken individually and in sequence. The guidelines on how to conduct these SME group discussion will, from this point on, deal with Task Data Forms that have been prepared to the task step level. The guidance is also applicable to Task Data Forms which have been prepared only to the task level.

Having read the tasks aloud, and having selected a subject task the interviewer now proceeds to read aloud those task steps constituting that task. Each step is then addressed individually by group discussion. If the selected task step is further described by task elements then, again, these elements are read aloud and form the basis on which evaluators will base their judgments. Before proceeding with the analysis, the interviewer further validates (and updates) the task description by group consensus. The task is then evaluated against each criterion in the order of its appearance on the Task Data Form (columns 1-11), concluding with the designation of training sites for primary and secondary training. Responses to each task evaluation criterion are given as a group consensus rather than on an individual basis and recorded by the interviewer in the appropriate code. This approach provides further validation of the task descriptions, enhances the reliability of the data being collected and decreases the time factor in data reduction.

3-7.4 Skills and Coordination Requirements Analyses

The last two columns of the Task Data Forms are completed by persons with both experience in conducting behavioral analyses and a knowledge and understanding of task performance within the system under investigation.

The actual completion of these two columns is done as a part of steps 3-9.3 and 3-9.6 so as to save unnecessary work. The details of how to complete these columns are presented here however.

3-7.4.1 Skills Requirements Analysis

A skill may be defined as an action having special requirements for its performance (e.g., speed, accuracy, etc.) and requiring some knowledge or experience for its execution. Any operator action lacking in special requirements and not requiring any prior knowledge or experience for its execution is considered an unskilled activity. As for example, "fire the weapon in `X` number of seconds following target detection" versus "stow ammunition in the vehicle" or "sweep the compartment floor."

Tasks/task steps must be analyzed to determine the skills required of the operator in order to identify inputs, transform input to outputs, and to receive or transmit outputs from/to other operators. Table 2 is a simple taxonomy of behavioral types which can be used to identify skill requirements of each task/task step. Persons knowledgeable in the behavorial sciences or training developments can use this taxonomy (augmented as may be necessary for a particular system) to classify the requirements of each task. The taxonomy is applied by determining the category (or categories) of behavior which best characterizes each task/task step/task substeps on the Task Data Form. The analyst reviews all elements required to perform a task and judges which one

Table 2. Behavioral Taxonomy Used to Perform a Skills Analysis of Operator Tasks

Code No.	Behavior Category	Definition
1	Procedure Following	Learning to carry out a series of discrete perceptual/motor acts in a fixed sequence, e.g., pre and post operation; starting the engine, or set-up of the turret.
2	Continuous Perceptual Motor Act	These types of tasks involve variable procedures where an action may be dependent on the results of other actions, e.g., a Gunner tracking a target receives a continuous stream of cues regarding the position of the target (the object he cannot control) and he receives continuous feedback as to the position of the object he can control (the turret mounted weapon).
3	Decision-Making (mental analysis)	This task involves choosing a course of action on the basis of facts, preestablished standards or criteria, prior experience, opinions or other information relevant to the decision, e.g., selection of the appropriate weapon based on target information and assessment of the tactical situation.
4	Visual Discrimination	Involves observing a display or a portion of the environment either continuously or by scanning in order to detect a specified kind of change, e.g., scanning for targets; selecting fighting positions; monitoring position in a movement.
5	Communication	Receiving and/or sending information either verbally or in other kinds of symbols, e.g., hand signals, voice, written orders, report forms, etc.

(or several) of the categories best describe the skill(s) required by the elements of the task.

If the Task Data Form provides only the task step then the selection of skill categories is based on this description alone. Likewise, if the Task Data Form presents only the task then the judgment is made at the task level and based on this description. If, however, task substeps are described then these descriptions are inputs to skill category selections made at the task or task step level. The digital code numbers representing the skills (see Table 2) inherent in the performance of the task step are entered in the "Skills Required" column on the Task Data Form. It is recommended that a minimum of two (2) trained persons participate in the skills analysis and that their entries on the Task Data Forms represent a consensus of opinion.

3.7.4.2 Coordination Requirements Analysis

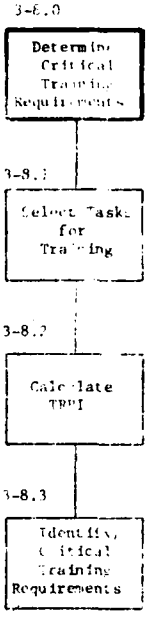
The mission-oriented system task descriptions identify whether tasks are performed individually or interactively, i.e., whether more than a single operator is involved in performing the activities comprising the task. Implicit in an interactive task is a required coordination between members of the crew or team operating the system that is vital to successful performance of that task. This task coordination can be considered a skill that is trainable. Hence, as part of the skills analysis, all interactive tasks are analyzed to identify the type of coordination during performance of the task. This information is used an an input to the determination of training device characteristics and to structure learning conditions.

The kinds of coordination involved during performance of interactive tasks are identified and defined in Table 3. For all tasks identified as having "Interactive Operators" (previously done under step 3-5.2), review the task steps and identify the kind(s) of coordination involved in the performance of that interactive task. Enter the appropriate code number(s) on the Task Data Form under the column labeled "Coordination Type".

Table 3. Kinds of Coordination Involved during Performance of Interactive Tasks

Code Number	Kind of Coordination	Definition
1	Physical	Occurs when two or more operators must collaborate physically in order to achieve a single immediate objective, e.g., install the 25mm gun.
2	Communicational	Occurs when the output(s) of one operator serves as an input(s) to another in order to achieve performance of the task, e.g., the command "LOAD TOW" causes positioning of the turret and launcher by the Gunner before the TOW Loader can load.

3-8.0 Determine Critical Training Requirements



The comprehensive task descriptions prepared in steps 3 and 7 identify and describe all individual and interactive tasks being performed by operators to accomplish system functions occurring in an operational environment. For many obvious and good reasons, some of these tasks will require no training at all and of those which do, variable amounts of training time will be required. Because of time and cost considerations in training program development and conduct, decisions must be made regarding which tasks will be trained and on which tasks to focus instructional resourses. These decisions are needed to assure that training time is efficient in that it is spent mainly in training those tasks considered most important to mission success. The purpose of this step is twofold: 1) to select tasks to be trained by eliminating those tasks not requiring training; and, 2) to determine which of the remaining tasks are critical training requirements.

3-8.1 Select Tasks for Training

A task is judged not to be a training requirement if the task received a zero (0) rating from the SMEs on any one of three characteristics: *Criticality, Newness, or Performance Difficulty. These three characteristics* are the first three evaluated on the Task Data Form (Figure 8). The rating scales for these characteristics (see 3-7.1) assign the number "zero" to indicate that no amount of the characteristic is present in the task. Thus, a zero rating given by the SMEs to "Criticality" indicates that the task is not critical and, if performed incorrectly, it would have no effect on mission success. A zero rating given to the task characteristic of "Newness" means that the task can be performed as a result of prior MOS training and there are no new skills involved. A zero rating assigned to "Performance Difficulty" indicates that adequate task performance is unskilled and requires no training or experience to accomplish.

The training developer screens each Task Data Form. Any tasks (or task steps, as the case may be) which have received a zero rating on any one of the above three characteristics are eliminated from further consideration. All tasks not receiving a zero rating on any one of the three are considered training requirements and enter the next step of the analysis: identification of the critical training requirements.

3-8.2 Calculate Training Requirement Priority Index

A Training Requirement Priority Index (TRPI) is used to order the tasks to be trained in terms of their relevance and importance in the operational situation (mission) and the extent to which some amount of

training must be given at some time. A TRPI is calculated for each task remaining after tasks not requiring training have been eliminated. This index is calculated by multiplying together the ratings assigned by SMEs to the task characteristics of "Criticality," "Task Newness," and "Frequency of Task Performance in Combat". (Depending on the number of operator tasks being analyzed, the training analyst may want to consider the employment of an electronic data processing system (computer) for sorting, calculating and assembling the task training data. Table 4 illustrates a computer printout of task and training data.)

The multiplication of the task ratings produce priority index numbers that range from one (1) to thirty-six (36) (see Table 4). An index of one (1) indicates that incorrect performance of the task would slightly degrade mission success, the task is not entirely new to the operator, and the task is rarely performed in the combat mission. At the other extreme of the range, an index of thirty-six (36) indicates that the task is extremely critical to mission success, it is a new task for the operator, and it is performed very frequently in combat operations.

3-8.3 Identify Critical Training Requirements

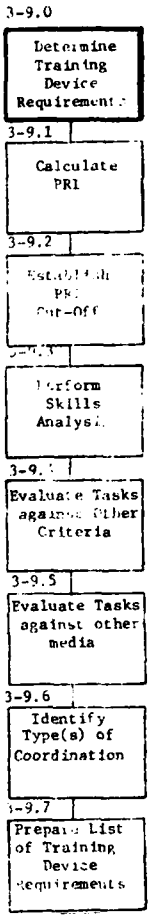
Training requirement priority indices can be used to structure training programs; to emphasize the training of tasks having a high priority index; and to reduce the number of tasks to be trained when costs, resources or training time are restrictive. This methodology uses the TRPIs to focus further analysis on those tasks which constitute critical training requirements. For this purpose all tasks having a TRPI value of twelve (12) or greater are considered critical training requirements and enter the next analysis step, which is the determination of training device requirements. All tasks having a TRPI of less than twelve are eliminated from further consideration. The minimum TRPI index of twelve (12) encompasses tasks which if not performed correctly would significantly degrade mission success; would require some amount of training because of its newness to the operator; or the task must be performed at least weekly in the combat situation.

OPERATOR 2 - Gunner

	TASK NUMBER	TRPI	TDRI	SKILLS REQUIRED	COORDINATION: TYPE	COORDINATION: OPERATORS	SITES: PR	SITES: SEC	JOB AIDS	CONDITIONS AFFECTING PERFORMANCE
1	09.3.02	36	18	2 3 4 5	1	1	1	2 3	0	1 3 5
2	09.3.03	36	18	3			1	2 3	0	
3	09.4.01	18	18	2 3 4 5	2	1	1	2 3	0	1 3 5
4	09.4.04	36	18	2 3			1	2 3	0	1 3 5
5	09.5.04	36	18	1 2 5	2	1	1	2 3	0	1 5
6	09.6.01	36	18	2 4 5	2	1 3	1	2 3	0	1 3 5
7	01.1.01	16	12	1 5	1	1 3 4 6	3	1 2	1	2 4 5
8	01.2.02	12	12	5	2	1	3	1 2	1	2 3 8 11
9	01.3.05	12	12	5	2	1	3	1 2	1	
10	08.3.01	24	12	3 4			3	2 1	0	1 6 11
11	09.1.01	36	12	2 4 5			1	2 3	0	1 5 6
12	09.1.02	36	12	4 5			1	2 3	0	1 5 6
13	09.1.03	36	12	2 4			1	2 3	0	1 5 6
14	09.2.01	36	12	4 5			1	2 3	0	1 3 5
15	09.4.02	24	12	2 3 4	2	1	1	2 3	0	1 3 5
16	09.4.03	24	12	2	2	1	1	2 3	0	1 3 5
17	09.5.00	36	12	2 4	2	1	1	2 3	0	1 5
18	09.5.02	36	12	2 4	2	1	1	2 3	0	1 5
19	09.5.03	36	12	2 4	2	1	1	2 3	0	1 5
20	03.3.03	36	9	1 2 3 5	2	4	1	2 3	1	1 5
21	01.1.02	12	8	1 5	1	1 3 4 6	3	1 2	1	5 11
22	02.5.02	12	8	1	2	1 3 4 6	1	2 3	1	1 10
23	06.1.06	24	8	1 4			1	2 3	1	1 3 7 10
24	06.4.04	24	8	4			3	2 1	0	1 6
25	08.1.01	36	8	1	1 2	1	3	2 1	1	3 9 10

Table 4. Computer Printout of Task and Training Data Used in the Analysis of Tasks to Determine Training Device Requirements.

3-9.0 Determine Training Device Requirements



The ISD model advocates a learning analysis to develop terminal learning objectives for tasks selected for training. The method contained herein digresses from the conventional ISD model in that it concentrates on which of the tasks constituting critical training requirements will require a training device. To support this decision with objectivity, these tasks are analyzed against criteria which, when considered collectively, identify requirements for a training device. These criteria include:

- A Practice Requirement Index (PRI) based on selected task characteristics
- Skills required to perform the task
- Job Aids provided to support performance of the task
- Conditions affecting task performance
- Other media options.

3-9.1 Calculate Practice Requirement Index (PRI)

The Practice Requirement Index (PRI) is the first criterion against which to assess tasks to determine the need for a device as a medium for training that task. A PRI is calculated for each of the tasks constituting critical training requirements (i.e., tasks having TRPI values of 12 or more) by multiplying the ratings on the criteria of: "Delay Tolerance" in performing the task, "Task Performance Difficulty" in the operational environment; and the "Amount of Practice Required" in order to maintain a desired level of proficiency. (See para. 3-7.1. These values are obtained from the Task Data Forms (Figure 8).) The product of these ratings will provide PRI values ranging from one (1) to a maximum of twenty-four (24). The values for these characteristics reflect the degree of need for practice to develop and/or maintain skill levels. A high rating on the task characteristic of "Delay Tolerance" indicates that immediacy or speed of response is important and that the skills required to perform the task should be developed to a designed proficiency level in order to respond effectively within a given time interval. A high rating on "Task Performance Difficulty" in the operational situation connotes a need for environmental simulation to train required skills adequately. (Ratings on this criterion may be further supported with data on the "conditions affecting performance"). High ratings on "Frequency of Practice"

identify those skills to be trained that must be exercised periodically in order to maintain a desired level of proficiency.

3-9.2 Establish PRI Cut-Off

The PRI is used to order tasks in terms of the extent to which initial and perhaps continuing practice is needed to assure an adequate task skill level. The index is used in the same manner as the TRPI; that is, to screen the tasks and to eliminate those with a low practice requirement from any further analysis. In short, those tasks presenting a very low practice requirement are considered to not require a training device as a training medium.

For the screening of tasks to determine training device requirements, a cut-off value of eight (8) for the PRI is used to identify tasks for further analysis. The minimum PRI value of eight (8) will identify those tasks that, for example, require daily practice, are fairly hard to perform but do not have to be initiated immediately, or, they are easy to perform but have to be initiated immediately. Tasks having a PRI value below the cut-off are eliminated from further consideration; those with a PRI value in the range of eight (8) to twenty-four (24) (see Table 4) are subject to further evaluation.

3-9.3 Perform Skills Analysis

The details of how to perform a skills analysis are described in para. 3-7.4. As a matter of efficiency, the actual conduct of the skills analysis is done at this point, on only those tasks remaining after application of the PRI cut-off criterion.

3-9.4 Evaluate Tasks against Criteria of Skills, Job Aids and Conditions

The tasks remaining after applying the cut-off value of the PRI are then further evaluated against other task characteristics (criteria) to identify those that require a device as a medium for training. These criteria include: 1) skills required to perform the task; 2) job aids provided to support the task; and 3) the internal and external conditions in the operational environment that affect task performance.

The skills criterion evaluation is based on the results of the skills analysis performed in step 3-9.3 above. The tasks that are retained for further evaluation to determine training device requirements include those tasks requiring skills such as "continuous perceptual motor ability," "decision making activity" or "visual discrimination" (see Table 2 for definitions and codes). These skills are generally considered to require interaction with functioning equipments and environments in order to be developed. Tasks not requiring these skills probably do not require close simulation of the functioning of the actual equipment for training purposes and are dropped from any further evaluation.

Job aids are sometimes provided to support the system opertor in performing required tasks. The effect of these aids is to improve system reliability and reduce the amount of training required for those operator skill requirements that the job aid is designed to support.

It is recognized that in order for a job aid to be effective it must be employed by operators having relevant capabilities and that some type and amount of training may be required. The training developer critically reviews those remaining tasks for which job aids are provided. The question is whether these tasks, given the job aid, still require training on equipment in order to develop the necessary skill levels. Those tasks which do not are eliminated from further consideration.

The final criterion against which the tasks remaining are evaluated to determine training device requirements is "conditions affecting task performance" (see para. 3-7.1). These data, collected during the task analysis, appear on the Task Data Form (see Figure 7) and in the summary of task and training data used in the analysis of tasks to determine training device requirements (see Table 4). The analyst examines the task elements and the conditions identified as affecting task performance and selects those tasks that: 1) can only be performed realistically under those conditions that seriously affect performance; e.g., vehicle motion; 2) involve personnel and/or equipment risk; and 3) are costly to reproduce operationally for training purposes, e.g., contact with the enemy, multiple targets and other stimulus inputs, or restricted visibility. These tasks have a greater need for a training device which can simulate the conditions because they can not be performed with actual equipment easily, cheaply or safely.

3-9.5 Evaluate Tasks against Other Training Media

As a final check to assure that all of the remaining tasks do indeed require training equipment to achieve and maintain the necessary skill levels, remaining tasks are evaluated against media other than training devices. The question asked by the training developer is whether any other media would do the training job satisfactorily if used in place of a training device. Types of media to be considered include:

- Audio tape with printed material
- Classroom with platform instruction
- Film or slides
- Technical manuals
- Computer aided instructional console

- Static mockup/panel
- Terrain boards

It should be noted that any of the above media may well be needed (in addition to a training device) as part of a complete training program; whether they are is not the question. The question at this point is whether such media could eliminate the need for training equipment, meeting the same training requirements.

3-9.6 Identify Type(s) of Coordination

The details of how to identify the types of coordination are described in para 3-7.4. Again, as a matter of efficiency, the actual conduct of this analysis is performed at this point and on only the remaining tasks. The types of coordination identified are entered on the remaining Task Data Forms (Figure 8).

3-9.7 Prepare List of Training Device Requirements

The output of this step in the task analysis process is a listing, by operator, of those tasks which require a device or functional equipment for effective training. Table 5 is a sample listing of training device requirements for a gunner. The additional data shown are provided to support the final stage of analysis, the determination of training device characteristics. The "Interactive Operators" column contains, per task, a listing of the specific other operators involved in performing a team task. If it is an individual task then no entry is made. This information is obtained from the Task Data Forms. "Coordination Type", training site, and "Conditions" information are also obtained from the Task Data Forms. Performance standards are derived from the information contained in the Task Data Forms and the System Data Forms (Figure 2).

Table 5. Sample Listing of Training Device Requirements for the Gunner Position in an Armored Vehicle

Task	Interactive Operators	Coordination Type	Sites: Prim.	Sites: Sec.	Performance Standard	Conditions
9.1 Detect/locate targets within assigned area reported by platoon headquarters			1	2, 3	Detect targets in assigned surveillance area within _____seconds after target enters area	1, 5, 6
9.2 Recognize/identify and report targets			1	2, 3	Correctly identify nine of ten targets, each within _____ seconds after detection	1, 3, 5
9.3 Adjust fire, 25mm gun	Track Commander	2	1	2, 3	Third burst on target within _____ seconds after fire command	1, 3, 5
9.4 Adjust fire, 7.62mm turret MG	Track Commander	2	1	2, 3	Third burst on target within _____ seconds after fire command	1, 3, 5
9.5 Attack stationary target with 25mm gun, HE	Track Commander	2	1	2, 3	Target hit within third burst and within ____seconds after detection	1, 5
9.6 Attack target with TOW	Track Commander	2	1	2, 3	First round target hit within _____ seconds after fire command	1, 5

3-10.0 Determine Training Device Characteristics

Training media consist of instructional aids and devices that vary from training films through complex simulators to the actual equipment. Training devices are a category of training media which enable hands-on performance in the form of repeated practice in order to develop and maintain those skills required to perform the tasks when using real equipment in a real operational environment.

This step in the methodology is concerned with the identification of "what" or "how much" is required in a training device, in terms of physical simulation of the operational equipment and instructional features, to promote the learning process. The question of fidelity or "how well" these characteristics should be represented to achieve the purpose of training and the design of an instructor station are not subjects of concern at this time. However, much of the task and training data developed in this methodology will also provide useful inputs to resolving these training device design problems.

Once the training developer has finished determination of the type(s) of training devices required (e.g., unit vs. institional) and the necessary simulation, it may be desireable to review the results with one final question in mind. That is, are the specified training device characteristics such that additional tasks could be trained with little or no modification? If any modification would be required, the training developer should carefully consider the TRPI, PRI, and other data on the tasks and the impacts on training device cost. If any additional tasks can indeed be trained with no, or cost-effective, modification to the characteristics requirements, then these tasks should be added to the list of tasks constituting the training device requirements.

3-10.1 Analyze Tasks to be Trained via Devices

The tasks passing all criteria in the training requirements analysis and the training device requirements analysis are further analyzed to determine training device characteristics. This analysis considers the following task and training data to determine "what" must be provided in the training device in order to promote those learning experiences that will facilitate the attainment of training objectives:

- Task steps (and substeps)
- Operational environment under which the task is performed
- The conditions affecting task performance

- Operators and type of coordination involved in interactive or team tasks
- Performance measures/standards
- Training sites for primary and secondary training
- System design and performance data.

Most of these data are contained in the training device requirements listing (Table 5) prepared in step 9.7. The detailed task data (substeps) are obtained from the Task Description Data Sheets (Figure 5). The system data are obtained from the System Data Forms (Figure 2) and from system design documentation.

Figures 9 and 10 show the format used to record the results of analyzing those tasks requiring a device for training. The example system task descriptions (column 1) are for Task 9.5, an interactive task performed by a Gunner (Figure 9) and a Track Commander (Figure 10), members of a team operating the weapons station in an armored vehicle. Conditions for training (column 2) are obtained from task statements in the task descriptions and supplemented with data obtained during the analysis regarding "Conditions Affecting Task Performance". The remaining columns on the Task Analysis Form are completed by analyzing the task elements that describe "how" the task is performed and the system and performance data that identify the equipment components used. The results of this analysis are an identification of task requirements in terms of: the inputs (stimuli and cues) that are required to initiate operator activity (column 3); the outputs or actions taken by an operator in response to the inputs (column 4); and the feedback or the results of the action taken (column 5). These task requirements are then translated into hardware requirements to be represented in the trainee station (column 6). Equipments that provide inputs include displays, instruments and other devices in the system that transmit information generated within the system or from the operational environment to the trainee; e.g., a visual device such as a day/night integrated sight transmits target (input) information; or an intercom is required to transmit auditory information such as "fire commands." In order to transform inputs to outputs, controls and other forms of equipment are required, e.g., gunner control handle or weapon control panel. Feedback provides the trainee with information regarding the outputs of the action taken. This information serves as an input to the operator and a decision is made as to whether any further action is required to produce the desired output. Simulation of feedback can be as simple as an indicator light to inform the trainee of the weapon selected or it may be as complex as simulating a burst with respect to a target under engagement.

ANALYSIS OF TASKS SELECTED FOR TRAINING DEVICES

Operator Position: Gunner

(1) Task No. and Title	(2) Conditions for Training	(3) Inputs	(4) Outputs	(5) Feedback	(6) Equipment Required
9.5 Attack stationary target with 25mm gun, HE	. Day . Stationary vehicle . Extreme weather - Rain - Snow - Sleet . Restricted visibility - Fog - Smoke	. Fire commands . Type of target - Stationary . Cease Fire	. Align reticle on target . Classify target . Insert elevation . Select weapon . Place ARM/SAFE to ARM . Squeeze trigger . Sense/apply corrections . Squeeze trigger . ARM/SAFE switch to SAFE	. Observe target alignment sight . Order to "Fire" . Observe super elevation scale . Observe weapon indicator . Observe ARM indicator . Burst with respect to target . Observe target alignment in sight . Burst on target . SAFE indicator on	. Intercom . Day/night integrated sight . Gunner control handle . Weapon control panel

Figure 9. Sample Format for Analyzing Tasks Selected for Training Devices.

ANALYSIS OF TASKS SELECTED FOR TRAINING DEVICES

Operator Position: Track Commander

(1) Task No. and Title	(2) Conditions for Training	(3) Inputs	(4) Outputs	(5) Feedback	(6) Equipment Required
9.5 Attack stationary target with 25mm gun, HE	. Day . Stationary vehicle . Extreme weather - Rain - Snow - Sleet . Restricted visibility - Fog - Smoke	. Type of target - Stationary	. Slew turret to target . Issue fire command . Sense/correct adjusting rounds . Evaluate weapon effectiveness . Report target destruction/ evaluation	. Target aligned in vane sight . Observe indications on weapon control panel . Observe effect of fire on target . Observe effect of fire on target . Return acknowledgment	. TC control stick . Vane sight . TC optical link through day/ night integrated sight . Intercom . Weapon control panel . Radio link

Figure 10. Sample Format for Analyzing Tasks Selected for Training Devices.

The conditions for training are important factors for consideration in determining the physical characteristics of a training device. These conditions are internal or external to the system and reflect the operational environment under which the task is performed. Conditions are used as a basis to determine "what" must be simulated, e.g., multiple targets, in order to create an environment in a training device which will provide those experiences that facilitate operator performance in an operational environment. These data also are used as inputs to establish a degree of flexibility in the training device by developing training problems or exercises of graduated levels of difficulty to meet training objectives. This is accomplished by varying the magnitude of the conditions to be simulated in the device or by alternating their presence/absence in the operational environment.

The type of coordination involved in interactive or team tasks, i.e., communicational and/or physical (Section 3-7.4), is considered in relation to the sites for primary and secondary training of the task to determine the configuration of the training device (i.e., a single vs. a multiple position trainer) and additional physical or instructional characteristics. In performing this evaluation, the training developer must bring to bear the knowledge and information gained during the study regarding the system's physical configuration, its employment in tactical situations, the facilities available, and how the device will be used to promote learning at the sites for training.

The inputs to the student required in a training device are culled from column 3 (inputs) and column 5 (feedback). These inputs come from the external environment or from within the system and serve to initiate task activity on the part of the trainee. The inputs coming from within the system are generally the result of interactive or team tasks wherein the output from one operator serves as an input to another. These inputs can be discrete such as command to "Fire" or continuous such as steering commands provided between a Gunner and vehicle Driver while engaging targets from a moving vehicle. Both of these examples involve a communicational type of coordination, a capability that must be incorporated into the training device and that can be used effectively for either individual or team training.

The example cited in Figures 9 and 10 is one of many interactive tasks involving both communicational and physical coordination by the Track Commander and Gunner located side-by-side at a weapon station in an armored vehicle. In this example, a weapons station trainer configured to incorporate both operator positions was recommended for training sites providing individual or collective training. For individual training, the instructor performs in the role of the absent operator and simultaneously monitors and assesses the trainee's performance during over-the-shoulder type of training. Additional controls are provided the instructor at the trainee's station to control the training exercise and to permit demonstration of criterion performance. In the later stages of primary training, the instructor may

choose to remove himself from the trainee's station and control the training exercise, provide the necessary inputs for interactive tasks and monitor trainee performance from a remoted position such as an instructor console. For secondary training, the device is used to train for and practice the coordination important to successful accomplishment of team tasks. A well designed team trainer also permits for cross-training between highly interactive operator positions.

The development of training problems and exercises is closely allied to the measurement and assessment of the trainee's performance. This is an important instructional feature that is discussed in more detail in Section 3-10.2. However, the decision to incorporate techniques for automatically measuring performance or directly observing performance by an instructor can influence the configuration of the device or necessitate adding physical features. Each task analyzed to determine "what" must be represented in the training device is evaluated against the measure of performance/standard for that task (Figure 8 and Table 5). This is done to ascertain that what is being provided in terms of physical characteristics in the trainee station will elicit the responses and outputs indicated in the performance measures/standards.

Table 6 is a sample of a listing of physical characteristics for a two-man weapon station trainer. The list identifies three categories of training device characteristics: 1) conditions for training; 2) inputs required to the trainee; and 3) equipment required at the trainee's station. This list is prepared from the task analysis results shown in Figures 9 and 10. Each operator task is reviewed and the required physical characteristics are transcribed in each of the categories, avoiding the redundancy that will occur because of the similarity of requirements between tasks or between operator positions being incorporated into a team training device.

3-10.2 Determine Instructional Characteristics

The literature presents much evidence concerning the beneficial effects of knowledge of results (KOR) or information feedback on learning and performance. In some systems, this information is inherent in the operational equipments; in others, it is not. For the latter situations, the training developer must carefully consider the benefits of providing some display of augmented feedback to the trainee without introducing any negative transfer to the operational situation. An example of augmented feedback in an armor vehicle weapon station trainer might consist of a red flashing indicator in the turret compartment to indicate that the vehicle has been disabled by the enemy because of an error of omission (failure to detect the target) or an error of commission (failure to deliver the weapon within prescribed time and/or accuracy limits).

A second instructional characteristic closely allied to KOR is the measurement of trainee performance. Performance measures provide an

Table 6. Sample of a Listing of Training Device Physical Characteristics Identified through the Task Analysis Process

Training Device Weapons Station Trainer

Conditions for Training	Inputs Required to the Trainee	Equipment Required at Trainee Station(s)
Environmental 1. Visibility . Day . Night . Extreme weather - Rain - Snow - Sleet - Sand 2. Noise External to Vehicle 3. Types of Terrain . Desert . Mountain . Built-up **Internal Vehicular** (System) 1. Turret Power On/Off 2. Turret Drive 3. Stabilization On/Off 4. Noise Internal to Vehicle 5. Stationary 6. Moving (Various Rates of Speed) 7. Optics 8. No Optics	**External** 1. Type of Targets . Moving . Stationary - Point - Area . Multiple - Tanks - BMP, PC - ATGM - Artillery - Trucks - Other type of wheeled vehicles - CP area - Personnel - Aircraft - Obstacles/mines 2. Range to Targets . Less than 1200 meters . Greater than 1200 meters 3. Bursts on Targets . TOW bursts on target . 25 mm gun bursts on target . 7.62 mm MG burst on target 4. Target Signatures . Soldier . Track vehicle . Anti-tank . Artillery . Aircraft . Obstacles/mines 5. Enemy Bursts 6. Friendly Forces 7. Platoon Communication	. TC Control Stick . Day/Night Integrated Sight (Gunner) . TC Optical Link Through Day/Night Integrated Sight . Intercom . Weapon Control Panel . Vane Sight . TOW Control Panel . TOW Abort (on Weapon's Control Panel) . Gunner Control Handle . Manual/Power Select Levers . Deflection and Elevation Handwheels . Turret Position Indicator . Azimuth Indicator Ring with HE/AP Load Position Indicators . Boresight Kit . 25 mm Gun . 7.62 mm Turret MG . TOW Launcher . Periscopes (Vision Blocks) (Gunner/Track Commander) . Red/White Internal Lighting . Radio . Night Vision Goggles . Turret Control Panel . Travel Lock

indication of the trainee's learning progress toward the attainment of training objectives. These data also are used by the instructor to brief the trainee on his strong and weak areas in task performance and to structure training problems that emphasize training in the weak areas.

The decision to provide a training device with a capability to measure trainee performance involves specifying "what", "how" and "when" to measure. The question of "what" to measure is obtained from review of system documentation describing system performance requirements (Figure 2) and from SMEs used as raters and evaluators during the task analysis (Figure 8 and Table 5). Measures for both individual and interactive (team) tasks are reduced to manageable units of performance that are observable and quantifiable. To enhance instructional value, the group of operator activities to be measured should contain both diagnostics (indicators of weaknesses or strength in the skills being trained) and terminal measures (indicators of the final output of the task being performed).

The determination of "how" to measure trainee performance should be a team effort composed of the training developer, training managers and design engineers. Design decisions should be made considering the following factors:

- Purpose and use of the training device in the overall training program
- Training objectives
- Population of trainees
- Individual/team training
- The instructor's role in the training situation
- State-of-the-art for information displays and recorders
- Value/cost

The measurement system in a training device provides measures of the trainee's outputs to allow the instructor to assess the learning situation, make any required adjustments and fulfill his primary role of providing instruction.

"When" to measure trainee performance is determined by the task and the environmental conditions programmed into the training problem. Measurements should be taken under a variety of task loadings and environmental conditions that are representative of those that the trainee will encounter in the operational situation. Both the measures to be taken and the conditions under which the trainee performs should be standardized to insure comparability between individuals, teams and learning experiences.

4.0 USE OF THE PRODUCTS

These procedures will result in considerable documentation and understanding of the jobs and training requirements for system personnel. If it is determined that training equipment is needed then the next step is preparation of a Training Device Requirement document (TDR). Certain products resulting from the foregoing analysis can and should be incorporated into the TDR either directly or through reference. These include: (1) the listing of tasks per position requiring training devices and (2) the required physical simulation characteristics of the devices including conditions, inputs to the trainee, and required equipment; Table 6 provides an example of format. The instructional characteristics, the device type (e.g., unit *vs.* institutional), and the device configuration (e.g., gunner position only *vs.* gunner, track commander and driver positions altogether) are best stated directly in the TDR.

The materiel development agency will be primary user of the documentation about the tasks constituting device/equipment requirements and about the system itself. All relevant task and system data should be submitted to this agency as the basis for developing the specification for the device and monitoring contractor performance.